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EDWARD D. COPE AND J. S. KINGSLEY,

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DR. C. O. WHITMAN, DR. C. E. BESSEY, PROF. C. M. WEED, PROF. W. S. BAYLEY, PROF. E. A. ANDREWS, PROF. W. H. HOBBS, DR. WM. ROMAINE NEWBOLD, MR. H. C. MERCER.

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CONTENTS.

LEADING ARTICLES.

Birds of New Guinea (Illustrated). GEORGE S. MEAD......1, 409, 627, 1056
Leuciscus Balteatus (Richardson) A Study in Variation (Illustrated). CARL H. EIGENMANN...... 10
On the Evolution of the Art of Working in Stone. J. D. MCGUIRE... 26
The Philosophy of Flower Seasons, and the Phaenological Relations of the Entomophilus Flora and the Anthophilus Insect Fauna (Illustrated). CHARLES ROBERTSON...... 97
Insanity in Royal Families, A Study in Heredity. ALICE BODINGTON. 118
The Significance of Anomalies. THOMAS DWIGHT...... 130
In the Region of the New Fossil, Daemonelix (Illustrated). F. C. KENYON...... 213
The Cold Spring Harbor Biological Laboratory (Illustrated). H. W. CONN...... 228
Minor Time Divisions of the Ice Age. WARREN UPHAM...... 235
The Skunk as a Source of Rabies. W. WADE...... 242
The Classification of the Lepidoptera. V. L. KELLOGG...... 248
On the Presence of Fluorine as a Test for the Fossilization of Animal Bones. THOMAS WILSON......301, 439, 719
Experimental Evolution Among Plants. L. H. BAILEY...... 318
Observations on a so-called Petrified Man. J. M. STEDMAN...... 326
On the Validity of the Genus Margaritana. C. T. SIMPSON...... 336
The Hereditary Mechanism and the Search for the Unknown Factors of Evolution. H. F. OSBORN...... 418
The Genera of Branchiostomidae. THEODORE GILL...... 457
Is Daemonelix a Burrow (Illustrated)? E. H. BARBOUR...... 517
On Successive Protandric and Proterogynic Hermaphroditism in Animals. T. H. MONTGOMERY, JR...... 528
Sponges Recent and Fossil (Illustrated). J. F. JAMES...... 536
The Mouth-Parts of the Lepidoptera. V. L. KELLOGG...... 546
The Symbiosis of Stock and Graft. E. F. SMITH...... 615
On a Supposed Case of Parallelism in the Genus Palaeosyops (Illustrated). CHARLES EARLE...... 622
On a New Classification of the Lepidoptera (Illustrated). A. S. PACKARD......636, 788
Investigations Concerning the Etiology of Small-Pox (Illustrated). J. C. BEY...... 699
The Affinities of the Lepidopterous Wing (Illustrated). V. L. KELLOGG...... 709
Contributions to Coccidology. T. D. A. COCKERELL...... 725
The Present Standing of the Florida Manatee, *Trichechus latirostris* Harlan, in the Indian River Waters. OUTRAM BANGS...... 783
Deviation in Development due to Unripe Seeds. J. C. ARTHUR...804, 904
The Effect of Female Suffrage on Posterity. JAMES WIER, JR...... 81

The First Fauna of the Earth (Illustrated). J. F. JAMES............880, 970
Organic Variations. C. MORRIS.. 888
Root Tubercles of Leguminosae. E. F. SMITH............................ 898
The Distinction between Animals and Plants. J. C. ARTHUR............ 961
Notes on the Reproduction of Plumularian Hydroids (Illustrated). C. C. NUTTING.. 966
Antidromy in Plants (Illustrated). G. MACLOSKIE........................ 973
Sargent's Studies of the Forests of Japan. C. E. BESSEY 1049
The Classification of the Lepidoptera on Larval Characters. H. G. DYAR.. 1066

EDITOR'S TABLE.—Meeting of Scientific Societies at Baltimore, 136; Scientific Exploration, 136; Modern Systematic Writers, 345; Endowment of Original Research, 345; Antarctic Exploration, 346; Wood's Holl, a correction, 347; The Philadelphia Academy and Lieutenant Peary, 347; Coeducation, 825; Execution by Electricity, 827; The Field Museum, 827; The Challenger Exploration, 828; The American Association for the Advancement of Science at Springfield, 913; The International Bibliographical Bureau, 914; The Date of Publication, 914; Officials in the Postal Department, 915; Science and the Agricultural Department, 915; The U. S. Commissioner of Fish and Fisheries, 916; How to get Separates of Papers in the Naturalist, 916; The Peary Expedition 985; The Extermination of Mosquitoes. 986; The Promotion of Scientific Societies............................ 1142

RECENT LITERATURE.—Packard on the Inheritance of Acquired Characters, 34; Proceedings of the Indiana Academy of Science for 1893, 35; The Mesozoic Echinodermata of the United States, 138; Tertiary Rhynehophorus Coleoptera of the United States, 138; The Fishes of Pennsylvania, 139; The Glacial Nightmare and the Flood, 258; Life Histories of North American Birds, 258; Geology of the Coastal Plain of Alabama, 259; Thirteenth Annual Report of the U. S. Geological Survey for 1891–92, Part II, 259; Reports of the Geological Survey of Arkansas, for 1891 and 1892, 260; Botany in the Secondary Schools, 348; The New Check-List of Plants, 349; Bulletin of the U. S. Fish Commission, Vol. XII, 351; Paleontology of Missouri, Part I, 352; Ord's Zoology, 459; The Life of Richard Owen, 460; The Cambridge Natural History, 557; Marshall's Biological Lectures and Addresses, 558; Butterfly Hunters in the Caribbees, 558; L'Amateur de des Papillons, 559; Monographic Revision of the Pocket Gophers, 559; Monograph of the Bats of North America, 560; Some Recent Text-Cooks and Student Guides, 647; Comstock's Manual for the Study of Insects, 649; In Bird Land, 650; From the Greeks to Darwin, 828; The Glacial Nightmare and the Flood, 830; Rambles in Alpine Valleys, 916; Lead and Zinc Deposits of Missouri, 916; Minot's Land-Birds and Game-Birds of New England, 917; Birds of Eastern North America, 917; Origin of Inventions, 918; A Pretty Book on Plants and Insects, 918; Bulletin of the U. S. Fish Commission for 1893, 986; Geological Survey of Michigan, Vol. V, 987; Geology of Minnesota, 987; Flora of Denver, 1073; Two Plant Catalogues, 1073; Flora of Passadena, 1074; Frank's Diseases of Plants,

1074 ; Wilson's Atlas of Karyokinesis, 1075 ; Scudder's Book on Butterflies 1076

RECENT BOOKS AND PAMPHLETS.—31, 140, 261, 353, 460, 560, 647, 732, 831, 919, 998.. 1077

GENERAL NOTES.—*Mineralogy*,—Identity of Rhabdite and Schreibersite, 37 ; English's New Catalogue of Minerals, 37 ; Leadhillite from near Granby, Missouri, 38 ; Two new Instruments for Mineral Study, 38 ; Miscellaneous Notes, 39, 838, 994 ; Minerals from the Chromite Deposits of Lower Silica, 148 ; Artificial Reproduction of Anhydrite from Evaporation of Salt Solutions, 148 ; Artificial Crystals of Zinc Oxide, 149 ; Artificial Copper Crystals in Aventurine Glass, 149 ; New Minerals, 149, 655 ; New Instruments, 266 ; Goniometer with two Graduated Circles, 266 ; Universal Goniometer, 267 ; Mier's Inverted Goniometer, 267 ; New Goniometer Lamp, 267 ; Darkening Attachment for the Goniometer, 268 ; Lecture Microscope, 268 ; Czapski's Ocular, 268 ; Klein's Lens with Micrometer, 269 ; Symmetry of Nepheline and Davyne, 358 ; The Minerals of the Emery Deposits of Naxos, 358 ; Boleite and Cumengeite, 359 ; The Formula of Pseudobrookite, 360 ; Formula of Staurolite, 361 ; Fletcher, The Optical Indicatrix and the Transmission of Light in Crystals, 467 ; Hecht, Introduction to the Calculation of Crystals, 467 ; Behrens, Manual of Microchemical Analysis, 467 ; Baumhauer, Results of Methods of Etching in Crystallographical Investigation, 467 ; Czapski, Theory of Optical Instruments, 468 ; Fuess, Instrument Catalogue, 469 ; Klockmann, Text-Book of Mineralogy, 469 ; Origin of the Pflockstruktur of Mellilite, 563 ; Blowpipe Coatings on Glass, 563 ; Use of Phosphorus in Stndying Minerals of High Refractive Index, 564 ; Chalcocite from Monte Catini, 564 ; Dioside and Apatite from Zoftan, 564 ; Serpierite, 565 ; Lautite, 565 ; Study of Optical Anomalies by Artificial Coloring, 565 ; New Method of Illuminating in Photomicrographic Work, 565 ; Chemical Behavior of Dimorphous Minerals, 566 ; Pearls, 566 ; Vicinal Planes and the Variation of Crystal Angles, 653 ; Determination of the Principal Indices of Refraction for the most Important Rock-making Minerals, 654 ; Doelter, The Characters of Gems, 655 ; New Edition of Groth's Physical Crystallography, 734 ; Tables of the Thirty-two Classes of Crystal Forms, 736 ; Universal Stage for the Microscope, 834 ; Connection between Atomic Weight of Contained Metals and Morphological and Optical Properties of Crystals, 835 ; Boleite and Nautokite from Broken Hill, N. S. W., 837 ; New Minerals from Chili, 837 ; An Instrument for preparing accurately Oriented Sections and Prisms for Crystals, 990 ; An Instrument for Producing Monochromatic Light of any Wave Length, 991 ; Other Mineralogical Apparatus, 991 ; Determination of Optical Sign in Random Mineral Sections, 992 ; Pseudochromism and Pseudodichromism, 992 ; Meteorites in Field Columbian Museum, 993 ; Crystallography of Wisconsin Minerals.. 993

Petrography.—The Serpentines of San Francisco, 41 ; The Blue Hornblende in the California Schists, 41 ; The Diorites, Gabbros and

Amphibolites of Argentina, 42; Amphiboles in Russian Rocks, 43; The Basalt Boulders from Thetford, Vt., 44; Maryland Granites, 44; Geology of Angel Island, San Francisco Bay, 152; A New Rock Volcanite, 153; Acmite Trachytes from Montana, 153; Petrographical Notes, 154, 364, 473, 569, 740, 997; Some Basalts of Asia Minor, 362; The Igneous Rocks of the Eureka District, 362; Notes from Minnesota, 363; The Geology of Dartmoor, England, 364; Granite Inclusions in Gabbro, 470; The Geology of Pretoria, South Africa, 470; The Gabbro of the Adirondacks, 471; The Dykes of the Thousand Islands, 472; Analcite Diabases from California, 472; A Quartz-Keratophyre from Wisconsin, 473; Notes, 473, 569, 740, 997, 1082; The Eruptive Rocks of the Christiana Region, 567; The Massive Rocks of Arran, 568; Migration of Crystals from a Younger to an Older Rock, 569; Rock Differentiation, 656; The Metamorphism of Inclusions in Volcanic Rocks, 657; The Petrography of Aegina and Methana, 658; Maryland Granites, 659; Alabama Cherts, 659; An Example of Rock Differentiation, 737; The Serpentines of the Central Alps, 738; Dynamic Metamorphism, 739; The Rocks of Gouverneur, N. Y., 994; Diorites and Gabbro at St. John's N. B., 995; South American Volcanics, 996; Rock Classification, 997; The Lherzolites of the Pyrenees and their Contact Action, 1079; Nepheline Rocks from the Kola Peninsula, 1080; The Matrix of Naxos Corundum, 1081; Formation of Dolomite 1083

Geography and Travels.—Zoological Explorations, 45; An Expedition to Labrador, 143; African Volcanoes, 264; Greatest Forest in the World, 356; Greenland Scientific Expedition of 1895 463

Geology and Paleontology.—Meunier on Meteorites, 157; The Origin of Bitumens, 157; Changes in Ore Deposits, 158; Dean on Coprolites, 159; New Molluscan Forms from the Dakota Formation, 159; Glacial Lakes in Western New York, 160; Geological News, 161, 272, 369, 478, 578, 664, 844; Relations of Devonian and Carboniferous Faunæ, 270; Characters of Glossopteris, 270; Geological History of the West Indies, 271; Fossil Mammals of the Lower Miocene White River Beds, 272; Origin of the Continental Area of Australia, 366; The Carboniferous System of Brazil, 367; The Affinities of Agriochaerus, 368; The Mastodons of Russia, 368; The Lakes of Central Africa, 474; Structure of Triarthrus, 475; Land Animals of the Canadian Paleozoic, 476; The Devonian System of Eastern Pennsylvania and New York, 476; The English Tarns, 477; The Loess of Northern China, 478; Niagara and the Great Lakes, 570; Paleozoic Insects, 572; The Phylogeny of the Whalebone Whales, 572; Two New Species of Dinictis from the White River Beds (Illustrated), 573; The California Coast, 660; Disintegration of Granite, 660; Dolomites from the Northwestern States, 661; The Silver Mines of Lake Valley, New Mexico, 661; Erosion of Submerged Limestones, 663; Irrigation of Western Kansas, 664; Plistocene Deposits in Switzerland, 664; Dawson on the Oscillations of the Behring Sea Region, 741; Green Pond Conglomerate, 745; Notes on the Osteology of *Zeuglodon cetoides*, 745; The Protole-

nus Fauna, 839; Formation of Oolite, 840; The Extinction of Saurians, 841; The Geology of Cuba, 841; Former Altitude of Greenland, 842; Age of the Sandstones of Crowley's Ridge, 843; Faunal Migrations, 922; A New Geomyid from the Upper Eocene, 923; Cenozoic History of the Baltic Sea, 924; Fossil Elephants of Tilloux, 925; The Latest Connection between the Atlantic and Pacific Oceans, 926; A Batrachian Armadillo, 998; Cope on the Temporal Part of the Skull, aud on the Systematic Position of the Mosasauridae, a reply, 998; Reply to Dr. Baur's critique on my paper on the Paroccipital Bone of the Scaled Reptiles and the Systematic Position of the Pythonomorpha, 1003; Recent Elevation of New England, 1005; On a New Species of Diplacodon, with a Discussion of the Relations of that Genus to the Telmatotherium, 1084; Discovery in the Oligocene of South Dakota, of Eusmilus, a Genus of Sabre-toothed Cats new to North America. 1091

Botany.—The Wild Flowers of America, 49; Willis' Practical Flora, 50; The Systematic Botany of North America, 164; Botanical News, 165, 748; Some Botanical Collections, 274; Some Recent Botanical Papers, 276; Nitrogen Fixation in Algae, 371; Rules for Citation, 373; Notes on Mexican Lichens, I, 480; The Simultaneons Origin of Similar (or identical) Varieties from Different Stock, 485; Some Features of the Native Vegetation of Nebraska, 486; The Division of Agrostology, 487; Gray's Field, Forest and Garden Botany, 488; Progress of the Botanical Survey of Nebraska. 580; Pharmaceutical Botany, 582; A Protest against the "Rochester Rules," 666; The Missouri Botanical Garden, 668; A New Astragalus, 670; Decades of North American Lichens, 747; North American Species of Polygonum, 747; Summer-School Botany in the Mountains, 845; Notes on Recent Botanical Publications, 926; Fertilization of the Yellow Adder's Tongue, 928; "Aboriginal" Botany, 928; New Species of Physalis, 928; The Mycetozoa, 929; Sacaline, 1007; Saccardo's Sylloge Fungorum. 1008; North American Fungi, 1008; Hough's American Woods, 1008; Seymour's Grasses and Grass-like Plants of North America, 1008; The Vienna Propositions 1093

Vegetable Physiology.—What becomes of the Flagella?, 583; Perithecial Stage of the Apple-Scab Fungus, 583; Poisonous Cactacea, 584; Rothert on Heliotropism, 585; Austro-German Views on Botanical Nomenclature, 585; Separation of Enzymes, 586; The Action of Light on Bacteria, 671; The Pole of Calcium and Magnesium, 674; Woronin on Sclerotinia, 749; Demonstration of Photosyntax by Bacteria, 750; Detection of Glukose by Auxanographic Methods, 752; Fischer on Bacteria, 847; The Mushroom Gardens of South American Ants, 851; Bactericidal Action of Metals. 933; Macfarlane on Paraheliotropism, 1100; Chalazogamy in *Juglans regia* 1103

Zoology.—The Sensory Canal System of Chondrosteans, 52; The Hypophysis, 52; The Species of Bothriocephalus, 53; Batrachia of Vincennes, Indiana, 53; List of Snakes Observed at Raleigh, N. C., 56; An Abnormal Pes of *Columbia livia* (Illustrated), 57;

Zoological News, 58, 171, 285, 380, 493, 680, 760, 862, 942, 1110; The Influence of Changed Environment on Mollusca, 167; The Genus Leptophidium, 167; The Habitat of the Salamander *Linguælapsus annulatus*, 168; The White Headed Eagle in Northern Ohio, 168; The Paludicolae, 170; Mexican Glires, 171; The Central Nervous System of Teleosts, 278; New Deep Sea Fishes, 281; Preliminary Notes on the Osteology of the North American Crotalidae, 281; The Senses of Pilumnus, 376; More Deep Sea Fishes (Illustrated), 376; Destruction of Food Fishes, 377; A Swallow Roost at Waterville, Maine, 377; The Distribution of Seeds by Birds, 378; The Effects of Cold, 379; Web-Spinning Spiders, 490; Fishes of the Northwest, 490; Queer Misfortunes of Birds, 492; The Cotton-Tail Rabbit, 493; Habits of Limpets, 587; Life History of the Lobster, 587; The Gas in the Swim-bladder of Deep Sea Fishes, 587; A new Locality for *Abastor erythrogrammus*, 588; The Cold Storage Warehouse Cat, 588; A New Harvest Mouse from Florida, 589: The Faunal Regions of Australia, 674; Notes on a Snapping Turtle's Nest, 676; On some new North American Snakes, 676; The Characters of the Enchytraeid Genus Distichopus, 753; New Mollusca from the Pacific, 756; Taylor on Box Tortoises, 756; The Genera of Xantusiidae, 757; Occurrence of the Siberian Lemming-Vole (Lagurus) in the United States, 758; The Introitus Vaginae of Certain Muridae, 759; Irish Fresh-water Sponges, 854; Reproduction of the Edible Crab, 854; The Odonata of Lower California, 855; Baur on the Temporal Part of the Skull, and on the Morphology of the Skull in the Mosasauridae (Illustrated), 855; A new Xantusia, 859; Bats of Queen Charlotte Islands, B. C., 860; Migrations of the Lemning, 861; The Brain of Microcephalic Idiots, 861; Antivenine, 936; Dall on the Lamellibranchiata, 938; On the Species of Uma and Xantusia, 938; Comparison of Marriages and Births in the Different European Countries, 939; Additions to the Mammal Fauna of British Columbia, 940; A Stratified Lake Fauna, 1011; Sexual Rights and Lefts (Illustrated), 1012; The Bats of Cuba, 1014; Fatigue and Toxicity, 1014; Poisons of Putrid Fish, 1015; Variation in *Halicystus octoradiatus*, 1104; The Role of the Liver in the Anticoagulating Action of Peptone, 1105; The Noviformation of Nerve-cells in the Brain of the Ape after a Complete Removal of the Occipital Lobes, 1106; The Æstivation of Snails in Southern California, 1106; A Careless Writer on Amphiuma......... 1108

Embryology.—Optimum Temperature for Incubation, 62; Cell Lineage, 62; Fertilization in the Earthworm, 62; Cleavage in Batrachia, 63; Development of Sponges, 64; Development of an Isopod, 180; Sexually Produced Organisms without Maternal Characters, 286; Double Monsters, 287; Fusion of Blastomeres, 288; Temperature and Development, 288; A Problematical Structure in a Mammal, 289; Development of Scyphomedusae, 289; Blastomeres of Medusae, 290; Development in Rarified Air, 291; Cytotropism, 385; Ascaris Eggs and Temperature, 499; Isolated Blastomeres in Ascidians, 500; Frog's Eggs in Salt Solution, 501; Stimuli in Embryology, 502; Grafting Amphi-

bia, 590 ; The Embryo of the Duckbill, 592 ; Origin of Twins, 686 ; Half Embryos versus Whole Embryos, 769 ; The Mouse's Egg, 770 ; Conjugation in an American Crayfish (Illustrated), 867 ; Eggs of Nematodes, 945 ; Cell Phenomena in the Triton Egg, 947 ; Conjugation of the Brandling (Illustrated)......1021, 1121

Entomology.—Sight in Insects, 66 ; Origin of Reproductive Cells in Insects, 67 ; Alimentary Canal in Orthoptera, 68 ; North American Jassoidea, 68 ; The Use of Parasitic and Predaceous Insects, 69 ; Oviposition in Acridiidae, 70 ; The Use of Chinch Bug Diseases, 71 ; Two New Species of Lecanium from Brazil, 174 ; The Wood Leopard Moth (Illustrated), 175 ; Relaxing Insects, 176 ; Eyes of Phalangiidae, 177; Spread of *Otorhynchus ovatus*, 177; Two More New Species of Lecanium, 381 ; A New Trombidian (Illustrated), 382 ; The Cabbage Root Maggot (Illustrated), 495 ; Ohio Dragonflies, 496 ; A Unique Journal, 497 ; Loss by Fire, 497 ; Male Reproductive Organs of Beetles, 497 ; Lamp Chimneys for Breeding Cages, 498 ; The Name of the Southern or Splenic Cattle-fever Parasite, 498 ; Distribution of Injurious Insects, 681 ; An All-purpose Net, 682 ; *Picobia villosa*, 682 ; Preparing Orthoptera, 684 ; Recent Literature, 685 ; A New Tettix (Illustrated), 761 ; On the Early Stages of some Carabidae and Chrysomelidae, 762 ; *Cecidomyia atriplicis*, 766 ; Mexican Jumping Bean (Illustrated), 767 ; Chordeumidae or Craspedosomatidae, 862 ; On the Generic Names Strigamia, Linotaenia and Scolioplanes, 864 ; *Picobia villosa*, 866 ; Entomology at Springfield, 942 ; Pigments of Pieridae, 943 ; Sense of Sight in Spiders, 944 ; The Genera of Lysiopetalidae, 1017 ; Habits of Ants, 1019 ; Entomological Notes, 1017 ; Stemmatoiulus as an Ordinal Type......... 1111

Psychology.—The Burrowing Habits of Snakes, 74 ; Habits of *Heterodon platyrhinus* at Raleigh, 75 ; The Present State of Psychology, 292 ; Lloyd Morgan's Introduction to Comparative Psychology, 388 ; Psychical Research, 503 ; Mental Development in the Child and the Race : Methods and Processes, 687 ; The Problem of Instinct, 773 ; Professor Baldwin on Mental Development, 873 ; The Psychic Factor, 874 ; The Baboon Switch Tender, 875 ; Change of Habit in a Parrot, 875 ; Will and Reason in Animals, 948 ; Recent Work in Hypnotism, 1027 ; The Cebus and the Matches, 1031 ; Sand Swallows and Sawdust, 1031 ; Criminology, 1127 ; Habits of Nestor......... 1131

Archeology and Ethnology.—Certain Sand Mounds of the St. John's River, Florida, 76 ; Discovery of Shell Mounds in Chira Valley, Peru, 188 ; The Neanderthal Man in Java, 192 ; The Contention of Mr. J. D. McGuire, 298 ; The Results of Cave Exploration in Germany, 298 ; The Antiquity of Man at Petit Anse (Avery's Island) Louisiana, 393 ; Notes on a Collection of Archeological and Geological Specimens collected in a Trip to Avery's Island, February 1st, 1890, 394 ; Notes on Yucatan, 507 ; The Potter's Wheel in Yucatan 511

Anthropology.—The Antiquity of Man in North America, 593 ; Paleolithic Man, 599 ; Ancient Rope and Netting in Southwestern Florida, 694 ; Notes taken upon an Exploration of the Lehigh

and Susquehanna Valleys for the University of Pennsylvania in the summer of 1892, 778; Another Human Jaw of the Naulette Type, 876; Sandals in Yucatan, 876; Strange Hints for Anthropology, 877; New Evidence of Glacial Man in Ohio, 951; The Discovery of Aboriginal Netting Rope and Wood Implements in a Mud Deposit in Florida (Illustrated), 1032; A Preliminary Examination of Aboriginal Remains near Pine Island, Marco, West Florida.. 1132

Microscopy.—Formal as a Preserving Fluid, 82; On a New Method of Entrapping, Killing, Embedding and Orienting Infusoria and and other very small Objects for the Microtome (Illustrated), 194; Preservation of some Marine Animals, 399; Cytotropism of Cleavage Cells.. 511

PROCEEDINGS OF SCIENTIFIC SOCIETIES 199, 402, 513, 600, 953, 1135

SCIENTIFIC NEWS 92, 200, 404, 514, 604, 695, 779, 959, 1040, 1137

INDEX.

AARON'S Butterfly Hunters in the Carribees, Review of 558
Abnormal Pes of *Columba livia*. S. D. Judd 57
Abastor erythrogrammus in Virginia 588
Aboriginal Botany 928
Aboriginal Netting Rope and Wood Implements in a Mud Deposit in Western Florida. C. D. Durnford 1032
Aboriginal Remains near Pine Island, West Florida. F. Cushing 1132
Academy of Sciences for Michigan 94
Academy of Sciences, St. Louis. 600
Aceratherium platycephalum 272
trigonodon 273
Acmite Trachytes from Montana 153
Acrasieæ 929
Acridiidae 70
Adams, G. I. New Species of Dinictis from the White River Beds 573
Aderhold's Perithecial Stage of the Apple-Scab Fungus, Abstract of. E. F. Smith 583
Aegerine 997
Aegina, Petrography of 658
Æluroedus buccoides 413
melanocephalus 413, 632
Æstivation of Snails. B. Williamson 1104
Affinities of the Lepidopterous Wing. V. L. Kellogg 709
African Volcanoes 264
Agnatha 493
Agriochaerus, Affinities of 368
Algonquin Natural Park 514
Alimentary Canal in Orthoptera 68
Allanite 994
Allen's Monograph of the Bats of North America, Review of. 560
Allolobophora foetida 1021
Amanita muscaria 760
Amaurochætaceæ 932
Amaurochætineæ 932
Amaurosporales 932
Amblyornis inornatus 414
subalaris 1064
Amblystoma opacum 55
punctatum 55
tigrinum 54
American Association Advancement Science. 913, 955
American Philosophical Society 600, 1136
American Physiological Society 200
American Microscopical Society 953, 609
American Morphological Society 200
American Society of Naturalists 199
Amœbopsis 758
Amphibia, Grafting of 590
Amphiboles in Russian Rocks 43
Amphibolites of Argentina 42
Amphioxides 458
Amphiuma 1108
Anableps 1012
Analcite Diabase from California 472
Ancistrodon contortrix 283
piscivorus 283
Andrews, E. A. On Conjugation in an American Crayfish 867
Conjugation of the Brandling 1021, 1121
Anemineal 932
Angel Island, Geology of 152
Anhydrite 148
Ainella 60
Annelids, Cambrian 982
Anocheta 1115
Antarctic Exploration 346
Anthropology, 593, 694, 778, 876, 951, 1032 1132
Antidromy in Plants. G. Macloskie 973
Antivenine 936
Antiquity of Man in North America. E. D. Cope 593
Antiquities in Florida 695
Apatite from Zoptau 564
Apt chus, Office of. 369
Archean Rocks in Western Australia 272
Arachnida 59
Archaeocyathus profundus 980
Archeology and Ethnology, 76, 188, 298, 393 507
Arcyriaceae 932
Arthur, J. C. Deviation in Development Due to the Use of Unripe Seeds. 804, 904
The Distinction between Animals and Plants. 961

Arvicola pallidus 758
Ascaris megalocephala 499, 945
Eggs and Temperature 499
Ascidians, Preservation of 401
Aspidiotus ancylus 731
dictyospermi 728
nerii 728
rapax 728
personatus 726
destructor 726
perniciosus 728
Association of American Anatomists 202
Astrarchia stephaniæ 1065
Aster novæ-angliæ 748
Astragalus lotiflorus var. *nebraskensis* 690
Asymmetron 458
Atomic Weight of Minerals 835
Atriplex canescens 730
Aurelia fluvidula 289
marginalis 289
Australia, Faunal Regions of ... 674
Australian Continent, Origin of 366
Museum 1140
Aves, 61, 172, 380, 494, 760 862

BABOON 875
Bacillus pyocyaneus 934
Bacteria 671, 750
Bactericidal Action of Metals ... 933
Bailey, L. H. Experimental Evolution Amongst Plants. 318
Baillon's Histoire des Plantes, Review of 748
Baldwin's Mental Development in the Child and the Race, Review of 687
Baldwin, On Mental Development (a correction) 873
Bangs' Distribution of the Cotton-Tail Rabbit, Abstract of. 493
O. The Present Standing of the Florida Manatee, *Trichechus latirostris*, in the Indian River Waters 783
Barbour, E. H. Is Daemonelix a Burrow? 517
Barite 994
Basalts of Asia Minor 362
Basalt Boulders from Thetford, Vt 44
Basiliite 655
Bates, J. M. Description of *Astragalus lotiflorus* Hook var. *nebraskensis* 670
Batrachia 60
Batrachia of Vincennes, Indiana 53
Batrachian Armadillo 998
Bats of Cuba 1014
of Queen Charlotte Island, B. C 860
Baur, On the Temporal Part of the Skull, and On the Morphology of the Skull in the Mosasauridæ, Review of ... 855
G. Reply to Cope on the Temporal Part of the Skull, and on the Systematic Position of the Mosasauridæ. 998
Bay, J. C. Investigations Concerning the Etiology of Small-Pox 699
Becke's Serpentines of the Central Alps, Abstract of 739
Beecher's Structure of Triarthrus, Abstract of 475
Behren's Manual of Micro-Chemical Analyses, Review of 467
Behring Sea Region 741
Bendire's Life Histories of North American Birds 259
Bell's Erosion of Submerged Limestones, Abstract of ... 663
Bergeat, On Guatemalan Volcanic Rocks, Abstract of ... 996
Bessey, C. E. Notes on Recent Botanical Publications 928
Notice of the 16th, 17th and 18th Decades of "North American Lichens" 747
On Sacaline 1007
Progress of the Botanical Survey of Nebraska 580
A Protest Against the "Rochester Rules" 666
Sargent's Studies of the Forests of Japan 1049
Review of Eastwood's Flora of Denver 1073
Review of Gray's Field, Forest and Garden Botany. 488
Review of Frank's Diseases of Plants 1074
Review of Hough's American Woods 1008
Review of McClatchie's Flora of Pasadena 1074
Review of Saccardo's Sylloge Fungorum 1008
Review of Seymour's Grasses and Grass-like Plants of North America ... 1008
Review of Wild Flowers of America 49
Review of Willis' Practical Flora 50
Some Features of the Native Vegetation of Nebraska 486
Beyrichona 839
Beyerinck. On the Detection of Glukose by Auxanographic Methods, Abstract of 752
Bibliography of America Economic Entomology 686

Biological Laboratory at Cold Spring Harbor........ 228
Bibliographical Reform.......92, 1137
Biological Society of Washington..............209, 402, 514, 1136
Survey of Indiana............ 406
Birds of Eastern North America 917
from Islands of the Malagassy Region.................. 61
of New England.............. 917
of New Guinea. G. S. Mead, 409, 627 1056
from Phillippine Islands.... 760
Bisilphide of Carbon.............. 685
Bitumens 157
Blastomeres in Ascidians 500
Fusion of.......................... 288
of Medusæ 290
Blowpipe Coatings on Glass..... 563
Blue Hornblende in the California Schists........................ 41
Bodington, A. Insanity in Royal Families...................... 118
Boeris, On the Chalcocite from Monte Catini, Abstract of.. 564
Boleite 359, 837
Bolton, On the Effects of Various Metals on the Growth of Certain Bacteria, Abstract of........................ 933
Born, on Grafting Amphibia, Abstract of 590
Boston Society of Natural History 208, 402, 514, 600, 1136
Botanical Collections............ 274
News 165
News 748
Papers, Recent 276
Publications 926
Survey of Nebraska, Progress of 580
Botany, 49, 164, 274, 371, 480, 580, 666, 747, 845, 923, 007, 1093
Boule's Fossil Elephants of Tilloux, Abstract of 925
Bothriocephalus Bremser......... 53
Bothriotaenia Railliet 53
Brachiopoda, Cambrian 981
Brachiospongia 542
Branchiostoma 458
Brandling 1021, 1121
Braus, On Cell Phenomena in the Triton Egg, Abstract of 947
Breeding-Cages for Insects 498
Brimley, C. S. Habits of *Heterodon platyrhinus* at Raleigh, N. C 75
C S. List of Snakes Observed at Raleigh, N. C.... 56
H. H and C. S. Habitat of the Salamander, *Lingualapsus annulatus* 168
British Association Advancement of Science............... 697
Brogger's Eruptive Rocks of the Christiana Region, Abstract of 567
Brogniart's Fossil Insects, Abstract of 572
Bromer's Variation in *Haliclystus octoradiatus*, Abstract of...... 1104
Bryophyllum 974
Bufo americanus...................... 147
variabilis 63
Bulletins of the U. S. Fish Commission for 1892 and 1893, Reviews of..................351, 986
Burramys parvus...................... 942
Burrowing Habits of Snakes. A. Gaines........................ 74
Bursulla 931
Butterflies............................. 685

CACTACEA, Poisonous.. 584
Caddice-fly, Wings of...... 717
Calcarineæ 932
Call's Age of the Sandstones of Crowley's Ridge, Abstract of.................................. 843
Caloenas nicobarica 1060
Calonemineæ......................... 932
Calvart's Odonata of Lower California, Abstract of.......... 855
Cambarus affinis......................... 867
Cambrian Fauna..................... 272
Cambridgea antopodiana 1020
Camponotus compressus............... 1019
rufoglaucus 1020
Cancer pagurus 854
Carboniferous System of Brazil. 367
Carpophaga luctuosa 1057
Cassias................................... 1101
Casuarina.............................. 1103
Catalogue of the Meteorite Collection in Field Museum... 993
Cats in a Cold-Storage Warehouse 588
Cave Exploration in Germany, Results of........................ 299
Caves of the Lehigh and Susquehanna Valleys 778
Cebus apella.............................. 1031
Cecidomyia atriplicis................. 766
Cell Lineage 62
Ceratiomyxaceæ..................... 931
Ceroplastes ceriferus 731
floridensis........................... 727
irregularis.......................... 730
Cerussite.............................. 994
Cetomimus gillii........................ 281
storerii............................... 281
Cetomimidae......................... 376
Chalcocite from Monte Catini... 564
Chalcochaps margaritæ............... 1059
Chalcopsitta scintillata............... 635
Challenger Expedition............ 828
Chamberlain, On the Former

Altitude of Greenland, Abstract of 842
Chapman's Birds of Eastern North America, Review of. 917
Characters of Glossopteris 270
Chelydra serpentina 676
Chervin's Comparisons of Marriages and Births in Different European Countries, Abstract of 939
Chibia carbonaria 629
megalornis 629
Chinch-Bug Diseases 71
Chionaspis citri 728
pinifolii 730
Chlaenius sericeus 763
Chlamydera 413
cerviniventris 414
Chlorarsenian 655
Chordeumidæ 862
Chrysophanus thoe 711
Chyletus norneri 684
Chytrideæ 930
Citation, Rules for 373
Cladodus clarkii 273
Classification of the Lepidoptera. V. L. Kellogg 248
of the Lepidoptera on Larval Characters. H. G. Dyar 1066
Clays of Long Island, Identification of 370
Cleavage in Batrachia 63
Clypeastrid from the Cretaceous of Colorado 369
Coccidology 725
Coccus confusus 728
Cochliopodidæ 796
Cockerell, T. D. A. Contributions to Coccidology 725
Description of *Cecidomyia atriplicis* 766
New Species of Lecanium from Brazil 174
New Species of Lecanium.. 382
Coeducation 825
Cœlenterata 58
Cœlenterates, Preservation of.. 400
Cold Spring Biological Laboratory, H. W. Conn 228
Cold, Effects of 379
Cole's Migration of Crystals, Abstract of 569
Collett. On the Migrations of the Lemming, Abstract of. 861
Collyriocincla brunnea 629
Comstock's Manual for the Study of Insects, Review of 649
Conglomerates of Hoosac Mt.... 740
Congress of Physiologists 781
Conjugation of the Brandling, 1021 1121
in an American Crayfish.... 867
Conn, H. W. Cold Spring Harbor Biological Laboratory 228
Conference of Evolutionists 782
Contributions to Coccidology. T. D. A. Cockerell 725
Cook, O. F. Chordeumidæ or Craspedosamatidæ? 862
On the Genera of Lysiopetalidæ 1017
On the Generic Names Strigamia, Linotaenia and Scolioplanes 864
Stemmatoiulus as an Ordinal type 1111
Cooke's Mollusca, Review of... 558
Cope, E. D. A New Locality for *Abastor erythrogrammus*.. 588
Antiquity of Man in North America 593
A Batrachian Armadillo.... 998
A Careless Writer on Ampiuma 1108
The Cebus and the Matches 1031
Collection Fossil Mammalia 698
Description of *Xantusia* 859, 939
The Genera of Xantusiidæ 757
Modern Systematic Writers 345
The Neanderthal Man in Java 192
On Some New North Amercan Snakes 676
On the Specie of Uma and Xantusia 938
Phylogeny of the Whalebone Whales, Abstract of... 572
Primary Factors of Evolution, Announcement of 1046
Review of Baur on the Temporal Part of the Skull, and on the Morphology of the Skull in Mosasauridæ.. 855
Reply to Baur's Criticism on the Author's Paper on the Paroccipital Bone of the Scaled Reptiles and the Systematic Position of Pythonmorpha 1003
Review of Taylor on Box Tortoises 756
Copper Crystals 149
Cornus canadensis 144
Corundum of Naxos 1081
Coupin's L'Amateur de des Papillons, Review of 559
Crag Fossils 698
Craspedosomatidæ 862, 1111
Cretaceous Flora of Long Island 370
Cricosaura 758
Criminal Suggestions 1029
Criniger chloris 635
Crotalidæ, North American 281
Crotalus Linne 284
Crossite 150
Crustacea 58, 493, 839
Cryptobranchus alleghaniensis 54

Crystal Angles, Variation of..... 653
Crystal Forms 736
Crystals, Symmetry of.......... 838
Crystallography, Physical....... 735
Ctenophores, Preservation of... 401
Cuba, Geology of................. 842
Cumengeite 359
Cunningham and Smith On the Brain of a Microcephalic Idiot, Abstract of........... 861
Cushing, F. A. Preliminary Examination of Aboriginal Remains near Pine Island, West Florida.................. 1132
Cut-Worms 585
Cyanea arctica..................... 289
Cyathophycus....................... 543
Cychrus elevatus.................... 762
Cylindrosoma....................... 1019
Cytotropism......................... 385
Czapski's Ocular.................. 268
Theory of Optical Instruments, Review of............. 468

D*ACTYLOPIUS solani*.......... 730
solani var. *striplex*......... 729
Daemonelix a Burrow ? E. H. Barbour......................... 517
Region of, F. C. Kenyon.... 213
Dall, On the Lamellibranchiata, Abstract of..................... 938
On New Mollusca from the Pacific, Abstract of.......... 766
Dana, James D..................... 515
Darapskite.......................... 838
Darkening Attachment for the Goniometer 268
Darton's Green Pond Conglomerate, Abstract of.............. 743
Dasyptilus pequetii.................. 1063
David's Origin of the Continental Area of the Australian Continent, Abstract of...... 366
Dawson, On the Oscillations of the Beh ing Sea Region, Abstract of 741
Synopsis of Air-Breathing Animals of the Canadian Paleozoic; Abstract of....... 476
Dean, On Coprolites, Abstract of 159
Death in the Hypnotic State ... 1030
DeBary, M........................... 931
Delboeuf, On Criminal Suggestion, Abstract of................ 1029
Deltoid Moths....................... 1020
Drepanornis albertisii................ 3
Derby's Carboniferous System of Brazil, Abstract of......... 367
Desmognathus fusca................. 55
Des Moines Academy of Science 208
Development in Rarified Air..... 291
of Sponges......................... 64
Deviation in Development Due to the Use of Unripe Seeds. J. C. Arthur..............804, 904
Devonian System of Eastern Pennsylvania and New York.............................. 476
Dictyostelium 929
Dictyphyton......................... 543
Diebitsch, E. Account of the Greenland Expedition of 1895................................ 463
Diemyctylus viridescens.............. 55
Dietzite............................... 838
Didymiaceæ.......................... 932
Dinictis from White River Beds 573
Dinictis bombifrons.................. 577
fortis 574
Dinosauria from the Upper Jurassic of Boulogne.......... 578
Diopside from Zoptau............ 564
Diorites of Argentina............. 42
Diornithidæ.......................... 844
Diplacodon emarginatus, Description of, with Discussion of the Relations of that Genus to Telmatotherium. J. B. Hatcher 1084
Diplogonophorus Lomberg...... 53
Diplotheca........................... 839
Diptera............................... 685
Diphyllodes magnifica................ 1
wilsonii............................. 410
Diplocheta........................... 1115
Directory of Botanists............ 698
Dispora variolæ...................... 706
Dissorophus multicinctus............ 998
Distichopus silvestris................ 753
Distomes.............................. 680
Distomum felinum.................... 681
westermannii........................ 680
Distinction Between Animals and Plants. J. C. Arthur.. 961
Division of Agrostology.......... 487
Doelter's Characters of Gems, Abstract of....................... 655
Dolomite, Formation of 1083
of the Northwestern States 661
Donax radiatus....................... 192
Doryphora (Mycocoryna) *lineolata*.................................. 764
Dragonflies, Ohio 496
Driesch's Isolated Blastomeres in Ascidians, Abstract of... 500
Drymadus beçarii.................... 634
Dubois, On the Physiological Conditions of Hibernation, Abstract of...................... 1027
Duckbill, Embryo of,.............. 592
Durkheim's Criminology, Review of 1027
Durnford, C. D. The Discovery of Aboriginal Netting Rope and Wood Implements in a Mud Deposit in Western Florida.............................. 1032

Dwight, T. Significance of Anomalies .. 130
Dyar, H. G. Classification of the Lepidoptera on Larval Characters .. 1066
Earle, C. On a supposed Case of Parallelism in the Genus Palæosyops .. 622
Eastwood's Flora of Denver, Review of .. 1073
Echinodermata .. 58
Echinoderms, Preservation of.. 400
Echinus microtuberculatus .. 286
Editor's Table, 136, 345, 825, 913 .. 985
Effect of Female Suffrage on Posterity J. Weir, Jr .. 815
Eigenmann's Fishes of the Northwest, Abstract of.. 490
Eigenmann, C. H. *Leuciscus balteatus*, a Study in Variation .. 10
Elaps fulvius .. 61
Electrocution .. 827
Elephant Rock of Transvaal.. 273
Elevation (recent) of New England .. 1007
Elfstorpite .. 655
Ellipsocephalus .. 839
Ellis and Everhart's North America Fungi, Review of. 1008
Embryology, 62, 180, 286, 385, 499, 590, 686, 769, 867, 945, 1021, 1047 .. 1121
Embryos of Frogs .. 769
Endosporeœ.. 930, 932
Endowment of Original Research .. 346
Englemann. On the Demonstration of Photosyntax by Bacteria, Abstract of .. 750
English's New Catalogue of Minerals .. 37
Entomology, 66, 174, 381, 495, 681, 761, 862, 942, 1017 .. 1111
Entomology at Springfield .. 642
Entrapping, Embedding, Killing and Orienting Infusoria and other small objects for the Microscope. J. A. Ryder .. 194
Enzymes, Separation of.. 586
Epididymite .. 149
Epidote .. 838
Epigonichthys .. 458
Epimachus magnus .. 5
vethii .. 4
Eremiomys lagurus .. 759
Eriocephalus calthella .. 1071
Errata .. 408
Eruptive Rocks of the Christiana Region .. 567
Erythronium americanum .. 928
Escherich's Male Reproductive Organs of Beetles, Abstract of .. 497
Eskers of New England .. 579
Esperella .. 64
Etheridge's Characters of Glossopteris, Abstract of .. 271
Ethmophyllum .. 541
Etiology of Small-Pox .. 699
Euciroa .. 756
Eulabes dumontii .. 633
Eupetes caerulescens .. 631
castanonotus .. 634
Eurygyrus .. 1018
Eutrygon terrestris .. 1059
Eusmilus dakotensis, Description of, J. B. Hatcher .. 1091
Evolution of the Art of Working in Stone. J. D. McGuire 26
Evotomus glareolus .. 759
Exosporeœ .. 930, 931
Expedition to Labrador. C. E. Hite .. 143
Expeditions, Scientific .. 782
Experimental Evolution Amongst Plants. L. H. Bailey .. 318
Explorations, Scientific .. 136

FAIRBANKS' Analcite-Diabases from California, Abstract of .. 472
Fairchild's Glacial Lakes in Western New York, Abstract of .. 160
aussek and Knipowitsch On a Stratified Lake Fauna, Abstract of .. 1011
Federow's Determination of Optical Sign in Random Mineral Sections, Abstract of... 992
Pseudochromism and Pseudodichromism, Abstract of.. 992
Universal Stage for the Microscope .. 834
Fernald's Plant Catalogues .. 1073
Ferri Lonigi .. 1043
Fertilization in the Earthworm 62
Field Museum .. 827
First Fauna of the Earth. J. F. James .. 880, 970
Fischer's Bacteria, Review of... 847
Fishes, 59, 171, 285, 494, .. 760
Deep Sea .. 281, 372
of Pennsylvania .. 139
Fixed Idea .. 1029
Flagella of Swarm Spores .. 583
Fletcher's Optical Indicatrix, Review of .. 466
Fluorine Presence as a Test of Fossilization of Animal Bones. T. Wilson .. 301
Food Fishes, destruction of .. 377
Forests of the World .. 356
Formal as a Preserving Agent. F. C. Kenyon .. 82

Frank's Diseases of Plants, Review of 1074
Fraser's Experiments on Snake Poisons and their Antidotes, Abstract of 936
Fuess' Instrument Catalogue.... 469
Fusicladium dendriticum....... 584
Fusion of Blastomeres ...., 288

GABBRO........................... 363
of the Adirondacks 471
of Agentina................ ... 42
of England..................... 470
Gaines, A. Batrachia of Vincennes, Indiana.......... 53
The Burrowing Habit of Snakes........................... 47
Galena Limestone 273
Garnet 994
Garman's Life-History of the Lobster, Abstract of 587
S. On Sexual Rights and Lefts 1012
Gasteropoda, Cambrian........... 981
Gaubert's Study of Optical Anomalies by Artificial Coloring, Abstract of. 565
Glacial Lakes in Western New York 160
Man in Ohio....................... 951
Gley and Pachon. On the Pole of the Liver in the Anticoagulating Action of Peptone, Abstract of.............. 1105
Glires, Mexican......................... 171
Globigerina............................... 839
Glukase 752
Genera of Branchiostomidæ. T. Gill 457
Gentil's Origin of the Pflockstruktur of Mellilite, Abstract of 563
Gems, Characters of 655
Geography and Travels, 45, 143, 264, 356 463
Geological News.—General...... 111
Archean, 161 272
Paleozoic, 161, 272, 369, 478, 578 664
Mesozoic, 162, 369, 479...... 665
Cenozoic, 162, 479, 579, 665, 844
Geology and Paleontology, 157, 270, 366, 474, 470, 660, 741, 839, 922, 998 1084
Geological Survey of Michigan, Vol. V, Review of.............. 987
Giacominis' Development in Rarified Air, Abstract of........ 291
Gigliolia 376
Gill, T. The Genera of Branchiostomidæ........................ 457
The Genus Leptophidium. 167
Girvanella 840
Gneisses, Classification of......... 1082
Goura albertisi.......................... 1058
Goura coronata 1058
sclaterii. 1059
victoriae................................ 1058
Gracula anais......................... 634
dumontii............................ 633
orientalis........................... 633
Graf's Fusion of Blastosmeres, Abstract of........................ 288
Granite, Disintegration of....... 660
Inclusions in Gabbro......... 470
of Maryland.................44, 659
of Pike's Peak.............. ... 1082
Graucalus mafoorensis............... 633
Graptolitha sebastianæ................ 768
Gravels of Long Island, identication of.......................... 370
Gray, Herbarium 926
Field, Forest and Garden Botany, Review of........... 488
Synoptical Flossa of North America.......................... 1138
Goldschmidt's Blowpipe Coatings on Glass, Abstract of.. 563
Goniometer with two Graduated Circles............ 266
Goode, G. B. and T. H. Beam's New Deep Sea Fishes, Abstract of............. ......281, 376
Gorham and Tower's Dissection of the Cat. 649
Greenland, Altitude of............. 843
Scientific Expedition of 1895............... 463
Green Pond Conglomerate....... 743
Grimsley's Maryland Granites, Abstract of 659
Groth's Physical Crystallography, Review of................ 734
Tables of Thirty-two Classes of Crystal Forms, Review of 736
Gundlach. On the Bats of Cuba, Abstract of 1014
Gymnomyxa............................ 931
Gymnophaps albertisii................ 1060

HABITS of *Heterodon platyrhinus* at Raleigh, N. C....... 75
Hallesus 716
Hall and Sardeson's Dolomites of the Northwestern States, Abstract of........................ 661
Hamilton. On the Poisons of Putrid Fish, Abstract of..... 1015
Hanitsch's Irish Fresh-Water Sponges, Abstract of 854
Hancock, J. L. Description of *Tettix incurvatus*................ 761
A new Trombidian............
On *Picobia villosa*................ 866
Hariotta.................................. 376
Harriotta raleighana.................. 281
Harker's Rock. Differentiation, Abstract of.......... 656
Harvey, F. L. On the Mexican Jumping Bean.................. 767

Hatcher, J. B. Discovery in the Oligocene of South Dakota, of Eusmilus......... 1091
On a new species of Diplacodon with a Discussion of the relations of that Genus to Telmatotherium........... 1084
Hedley's Faunal Regions of Australia of.................. 674
Hecht's Introduction to the Calculation of Crystals, Review of.................................. 467
Heliotropism.......................... 585
Helix traskii......................... 1107
veatchii.............................. 1107
Hemidactylium scutatum............. 55
Hemiptera of Colorado............ 1020
Hepialidæ............................... 780
Hepialus humuli..................710, 1078
mustelinus............................ 1069
sylvinus.........................250, 549
Herbarium of Columbia College 927
Herbst's Stimuli in Embryology, Abstract of............... 502
Hereditary Mechanism and the Search for the Unknown Factors of Evolution. H. F. Osborn 418
Hertwig's Development of Frog's Eggs in Salt Solution, Abstract of.............. 501
Hesperocichla nævia................... 61
Heterodermaceæ..................... 932
Heterodon platyshinus, Habits of.. 75
Hexanchus griseus..................... 1110
Hexapoda.............................. 59
Hibernation........................... 1027
Hicks, G. H. Botany in the Secondary Schools 348
Hill's Geology of Cuba, Abstract of........................... 841
Hill and Matin's Embryo of the Duckbill, Abstract of......... 592
Hippocephalus japonicus.............. 285
Hipponicharion........................ 839
Histology of Sleep.........................
Hite, C. E. Expedition to Labrador 143
Hobbs, W. H. New Minerals.. 149
On the Crystallography of Wisconsin Minerals, Abstract of........................ 993
Review of Behren's Manual of Microchemical analyses 417
Review of Groth's Physical Crystallograpy............... 734
Review of Czapski's Theory of Optical Instruments 468
Review of Groth's Tables of Thirty-two Classes of Crystal Forms........................ 736
Rev ew of Hecht's Introduction to the Calculation of Crystals........................ 467
Review of Fletcher's Optical Indicatrix 466
Review of Klockmann's Text-Book of Mineralogy... 469
Hopkins. On Pigments of Pieridæ, Abstract of.............. 943
Hovey's Alabama Cherts, Abstract of........................ 659
Howard's Distribution of Injurious Insects, Abstract of.... 681
Howorth's Glacial Nightmare and the Flood, Review of.. 830
Human Jaw, Naulette Type..... 876
Huxley, Thomas Henry, Obituary.................................. 779
Hyde's Development of a Scyphomedusa, Abstract of.... 289
Hymenoptera (parasitic) of the Island of St. Vincent......... 686
Hyolithus.............................. 839
Hyopotamus........................... 72
Hypnotism 1027
Hypophysis in Teleosts and Batrachians 52

ICERYA montserratensis.......... 731
rosæ 727
Identity of Rhabdite and Schreibersite.............................. 37
Igneous Rocks of the Eureka District............................... 362
Inclusions in Volcanic Rocks... 657
Indiana Academy of Science, 204,.................................... 695
Indices of Refraction for Certain Minerals 654
Influence of changed Environment on Mollusca 167
Insanity in Royal Families, Alice Bodington................ 118
Insecta...........................59, 380
Insect Anatomy 1020
Life...................................... 915
Enemies of the Apple Trees 685
Insects of the Clover Field....... 685
Fossil................................... 572
Injurious............................ 1021
Instinct 773
International Bibliographical Bureau 914
Zoological Congress.......... 614
Inventions, Origin of............... 918
Invertebrata........................... 58
Investigations Concerning the Etiology of Small-Pox. J. Christian Bay.................. 699
Iowa Academy of Science 206
Irrigation of Western Kansas .. 664
Iulus lactarius.......................... 1017

JABONCILLO........................ 359
James, J. F. The First Fauna of the Earth......880, 970
Recent and Fossil Sponges 536
Janet. On the Fixed Idea, Abstract of 1028

Joor, J. F. Notes on a Collection of Archeological and Geological Specimens from Avery's Island 394
Judd, S. D. Abnormal Pes of *Columba livia* 57
Judd's Granite Inclusions in Gabbro, Abstract of 470
Juglans regia 1103

KENYON, F. C. Abstract of Van Gehuchten's Central Nervous System of Teleosts 278
Formal as a Preserving Agent 82
In the Region of the New Fossil; Dæmonelix 213
Kellicott's Ohio Dræmplies, Review of 496
Kellogg, V. L. The Affinities of the Lepidopterous Wing 709
The Classification of the Lepidoptera 248
The Mouth-Parts of the Lepidoptera 546
Klein's Lens with Micrometer.. 269
Kenyon. On the Neoformation of Nerve-cells in the Brain of the Ape after a complete Removal of the Occipital Lobes, Abstract of 1106
Knower, H. McE. Abstract of Roule's Development of an Isopod 187
Krabbea R. Bl. 53
Krœber's Transpiration Experiments, Abstract of 1011
Kylindrite 151
Keyser's Bird-Land, Review of
Klockmann's Text-Book of Minerals, Review of 469

LABORATORY at Cold Spring Harbor 405
of the Division of Vegetable Pathology 927
Lacertilia 858
Lacroix' Metamorphism of Inclusions in Volcanic Rocks, Abstract of 657
Lagurus lagurus 758
Lautite 564
Lakes of Central Africa 474
Lake Fauna 1011
Lambellibranchiata 938
Cambrian 982
Lamprosporales 932
Lamprostibian 655
Land-Animals of the Canadian Paleozoic 476
Lautarite 838
Lawson's Topography of the California Coast, Abstract of 660
Lead Deposits of Missouri 916
Leadhillite from near Granby, Missouri 38
Lecanium baccharidis 174
hesperidum 728
hemisphæricum 728
longulum 728
putoratum 727
hemisphæricum 727
oleæ 727
lintneri 381
pseudohesperidum 381
reticulatum 174
ribis 731
Lecaniodiaspis yuccæ 728
yüccæ var. *rufescens* 730
Lecture Microscope 268
Legislation against Injurious Insects 1021
Lemming 861
Lepidium virginicum 977
Lepidoptera 248, 1066
Lepidoptera haustellata 648
laciniata 636
Lepidoptera, a new classification of 636, 788
Lepidophyma 758
Lepiodora hyalina 1027
Leptomitus 541
Leptophidium 167
Lepus americanus 144
sylvaticus 493
Leuciscus balteatus (Richardson) A Study in Variation, C. H. Eigenmann 12
lateralis 10
Lherzolites 1079
Liceaceæ 932
Lichens 747
Mexican 480
Liébeault. On Criminal Suggestion, Abstract of 1029
On the Psychology of Sleep, Abstract of 1027
Linguælapsus annulatus 168
Lingula antiqua 884
Limestones, Erosion of 663
Linotænia 864
Lipogenys gillii 376
Lister. On Mycetozoa, Abstract of 929
Lithosiidæ 799
Litorin Sea 924
Lobster, Life History of.. 587
Lœb's Origin of Twins, Abstract of 686
Lœss of Northern China 477
Lucas, F. A. Notes on the Osteology of *Zeuglodon cetoides* 745
Lumbricus terrestris 1021, 1025
Lycogalaceæ 933
Lynx canadensis 144
Lysiopetalum carinatum 1018
fœtidissimum 1018
lactarium 1018

Lysopetalidæ 1017
MACLOSKIE, G. Antidromy in Plants........................ 973
Mac Donald, Marshall............ 916
Macdonaldia 376
Macropterygidæ 862
Macropygia reinwardtii............. 1059
Macrocystis 748
Mammalia 61, 172, 285, 494, 761, 942
Arizona 285
Florida........................ 285
South Dakota................. 285
White River 272
Manucodia comrii.................. 631
chalybea 632
Man, Antiquity of, at Petit Anse, Louisiana 393
in North America............. 593
Paleolithic 599
Margaritaceæ 933
Margaritana confragosa Say....... 341
rugosa........................ 338
Marine Biological Laboratory at Wood's Holl, Mass 604
Marriages and Births in European Countries..................... 939
Marr's English Tarns, Abstract of 477
Marshall's Biological Lectures and Addresses, Review of.. 558
Mason's Origin of Inventions, Review of......................... 918
Massive Rocks of Arran........ 568
Mastodons of Russia.............. 368
Matias-Duval's Histological Theory of Sleep, Abstract of................................ 1027
Matthews On Diorites and Gabbro at St. John, N. B., Abstract of 995
Protelenus Fauna, Abstract of................................ 839
McDonald, Marshall............... 1042
McClatchies Flora of Pasadena, Review of......................... 1074
McGuire, J. D. On the Evolution of the Art of Working in Stone 26
McMurrick's Invertebrate Morphology, Review of 648
Mead, G. S. Birds of New Guinea 1, 409, 627, 1056
Medusæ, Blastomeres of......... 290
Medusites lindstromii............... 980
Megalopygidæ........................ 797
Melanopyrrhus anais................. 634
orientalis 633
Melanorectes 628
Mellilite 563
Melipotes gymnops.................. 635
Mercer, H. C. Abstract of C. B. Moore's Sand Mounds of the St. John's River, Florida.................................. 76
Mercer, H. C. Antiquity of Man at Petit Anse, Louisiana.................................. 393
Discovery of Ancient Rope and Netting in Southwestern Florida.................... 687
Exploration of the Lehigh and Susquehanna Valleys in the Summer of 1892...... 778
Notes on Yucatan. 507
The Potter's Wheel in Yucatan 511
Sandals in Yucatan......... 876
Merocheta 1115
Merops ornatus........................ 1057
Merriam, C. H. Bats of Queen Charlotte Island, B. C....... 860
Mexican Glires, Abstract of 171
Monographic Revision of the Pocket Gophers, Review of........................... 559
Occurrence of the Siberian Lemning Vole in the United States....................... 758
Merrill's Disintegration of Granite, Abstract of........... 660
Meunier's Meteorites Abstract of..................................... 157
Mesozoic Echinodermata of the United States.................. 138
Metamorphism, Dynamic....... 739
in Inclusions in Volcanic Rock.............................. 657
Metamynodon........................ 272
Meteorites............................. 157
Methana, Petrography of........ 658
Micropodiæ........................... 862
Micropteryx 711
Micropteryx purpurella............. 1070
unimaculella..................... 250
Microscopy.......... 82, 194, 399, 511
Microtus agrestis.................... 759
principalis 940
Miers' Inverted Goniometer.... 267
Vicinal Planes and the Variation of Crystal Angles, Abstract of 653
Migration of Crystals............. 569
Migrations, Faunal................. 922
of the Lemming.............. 861
Milch. On Dynamic Metamorphism, Abstract of 739
Rock Classification, Abstract of......... 997
Miller. On the Introitus Vaginæ of Certain Muridæ, Abstract of........................ 759
Mina robertsonii...................... 634
Mineralogy 37, 148, 266, 358, 466, 563, 653, 734, 834....... 990
Mineralogical News.
Minerals from the Chromite Deposits of Lower Silica... 148
of the Emery Deposits of Naxos.............................. 358
Minot's Course in Embryology,

Announcement of. 1047
Land and Game Birds of New England, Review of.. 917
Minor Time Divisions of the Ice Ags, W. Upham 235
Miodes nigripes....................... 61
Miscellaneous Notes, Mineralogical 39
Missouri Botanical Gardens..... 668
Geological Survey, Vols. VI & VII, Review of........ 916
State Horticultural Society 612
Molengraf's Geology of Pretoria, South Africa, Abstract of.......................... 470
Mollusca..............167, 493, 760, 839
Molluscan Forms (new) from the Dakota Formation...... 159
Monadinœ........................... 931
Monocheta 1115
Monomorium salomonis............. 1019
Monsters, Double......... 287
Montgomery, T. H., Jr. On Successive, Protandric and Proterogynic Hermaphroditism in Animals............. 528
Moore, C. B. Certain Sand Mounds of the St. John's River, Florida...... 76
J. P. The Characters of the Enchytracid Genus Distichopus............... 753
Morgan's Experiments on Frog Embryos. Abstract of........ 769
Introduction to Comparative Psychology, Review, W. R. Newbold,................ 389
Morris, C. Organic Variation 880
Theory of the Extinction of Saurians, Abstract of......... 841
Mosasauridæ......................855, 1001
Moseley, E. L. The White-headed Eagle in Northern Ohio 168
Mosquitoes, Extermination of . 986
Moths...... 1020
Mouth Parts of the Lepidoptera, V. L. Kellogg........... 546
Munthe. On the Cenozoic History of the Baltic Sea, Abstract of 924
Mus sylvaticus.......................... 759
Mycetozoa................................. 929
Mylodon harlanii.............. 397
Myrmicaria fodiens.................. 1019
Mystacides punctatus...... 715
Mytilaspis albus var. *concolor*...... 730
Myxogastres....... 929
Myxomycetes....... 929

NATICA panamensis............. 192
National Academy of Science..............402, 513, 1135
Nataix compressicauda tæniata.... 676
fasciata pictiventris............ 677
Natural Science Association, Staten Island 601
Naulette Skull......................... 876
Nautokite.............................. 837
Neanderthal Man in Java, E. D. Cope 192
Necturus maculatus.................. 54
Nelumbium 976
Nematodes................. 945
Neolepidoptera............... 645
Nepheline Rocks.................. 1080
Nephelene Synmites.............. 839
Nephylines and Davyne, Symmetry of.......................... 358
Neptunite.............................. 149
Nest of Snapping Turtle......... 670
Nestor, Nest of........ 1131
Net for Catching Insects......... 682
Neuronia 712
Newbold, W. R. Recent Work in Hypnotism................ 1027
The present State of Psychology 292
The Problem of Instinct... 773
Review of Baldwin s Mental Development in the Child and the Race.......... 687
Review of Morgan's Introduction to Comparative Psychology..................... 388
Review of Podmore's Psychical Research................ 503
Review of Van Norden's Psychic Factor 874
Will and Reason in Animals..... 948
Niagara and the Great Lakes. . 570
Nitrogen Fixation in Algæ 371
Nomenclature, American........ 927
Botanical......................... 585
Nolidæ....... 801
Nova Scotian Institute of Science ...., 402
Nutting, C. C. Notes on the Reproduction of Plumularian Hydroids 966
Russell's Explorations in the Far North......... 45
Nymphalis cardnus......... 553

Obituary.
Dana, James W...... 515
Ferri, Luigi 1041
Foote, Albert E. Dr 1144
Gizycke, G. von............... 1044
Huxley, Thomas H.......... 779
Lamborn, Robert H.......... 210
McDonald, Marshall......... 1042
Morris, Rev. J. G 1144
Riley, Charles T................ 959
Ruschenberger, William S. W.................. 405
Ryder, John A.................. 404
Odonata............ 855
Officialism in Postal Depart-

ment 915
Ohio Academy of Science....... 203
Ophibolus getulus......... 74
Ophidia......... 858
Optical Anomaliet, Study of.... 565
Indicatrix......... 466
Properties of Crystals 835
Optimum Temperature for Incubation 62
Orbulina 839
Ord's Zoology; Review of 459
Ore Deposits 158
Oreodon......... 272
Organic Variation, C. Morris... 880
Origin of Reproductive Cells in Insects......... 67
Oriolus striatus......... 630
Ornithorhynchus paradoxus....... 761
Ortheria annæ......... 730
nigrocincta......... 730
sonorensis 730
Orthoptera, oviposition of........ 70
preparation of......... 684
Osborn, H. F. Hereditary Mechanism, and the Search for the Unknown Factors of Evolution 418
Osborn's Fossil Mammalia of the Lower Miocene White River Beds, Abstract of...... 272
Greeks to Darwin, Review of.........
Osteology of the North American Crotalidæ, W. E. Taylor 281
Ostracoda 839
Otiorhyncus ovatus......... 177
Otheria insignis......... 727
Otidiphaps nobilis......... 1060
Orthotheca......... 839
Oviposition in Acridiidæ 70
Owen's Life of Richard Owen, Review of......... 460

PACHYCEPHALOPSIS *hattamensis*......... 630
Pachytheca......... 748
Packard, A. S. On a New Classification of the Lepidoptera...... ......636, 788
Packard's Inheritance of Acquired characters, Review of......... 34
Paleolepidoptera 644
Paleontology of Missouri, Vol. iv, Pt. I, Review of......... 352
Paleosyops......... 622
Palladino, Eusapia 1030
Paludicolæ 170
Panorpa 718
Paradisea apoda......... 2
gularis 2
Paramphioxus 458
Parallelism in the Genus Palæsyops, C. Earle......... 622
Parnopa 713
Parrot, Change of Habit in 875
Pasteur, Louis, Ob......... 1040
Patella vulgata, Habits of......... 587
Patton, W. H. Fertilization of the Yellow Adder's Tongue 928
Pavlov's Mastodons of Russia, Abstract of......... 368
Pear-borer......... 685
Pearls 566
Peary Expedition.........347, 985
Peckham. On Sense of Sight in Spiders, Abstract of...... 944
Peckham's Origin of Bitumens, Abstract of 157
Penrose's Changes in Ore Deposits, Abstract of......... 158
Peridotite 1082
Personal News 95, 210, 407, 514, 613, 698, 960, 1139, 1141, 1142, 1143......... 1144
Pes (abnormal) of *Columba livia* 57
Petrified Man, Observations on J. M. Steadman......... 326
Petrography 41, 152, 262, 470, 567, 656, 737, 994, ... 1079
New Books pertaining to... 155
Petrographical News 154, 364. 473, 569,......... 740
Notes......... 473
Phæthornis guyi......... 862
Phalangiidæ 177
Phallusia maniculata... 500
Phaseolus lunatus, Dwarf Variety of......... 485
Pheidole rhombinoda......... 1019
Phenacomys oramontis......... 941
Philosophy of Flower Seasons and the Phænological Relations of the Entomophilous Fauna and the Anthophilus Insect Fauna, C. Robertson. 97
Phoca vitulina......... 145
Phorbia brassicæ......... 495
Photomicrographic Work, Illuminating of......... 566
Photosyntax demonstrated by Bacteria 750
Phyllophilophis aestivus......... 75
Physalis cornuta......... 928
macrophysa 929
subulata 928
versicolor 928
versicolor microphylla......... 929
Physaraceae 932
Picobia villosa.......382, 384, 682, 866
Pieridæ 943
Pieris duplidice......... 553
Pilumnus hirtellus......... 376
Pilumnus, Senses of......... 376
Pinarolestes megarhynchus......... 629
Pipa americana......... 60
Piranga ludoviciana......... 61
Piroplasma bigeminum......... 499

Pitres, On a Case of "Fixed Idea," Abstract of 1029
Plagioclase 994
Plants and Insects 918
Plants of the Peary collection.. 927
Platops xanthina 1018
Plethodon cinereus 55
erythronotus 55
glutinosus 55
Pleurotominæ 756
Plistocene Deposits of Switzerland 664
Plumularia pinnata 66
Pocock's Web-Spinning Spiders Abstract of 490
Podmore's Psychical Research, Review of 503
Polygonum 747
Polygonum sachalinense 1007
Porcelio scaber 180
Porifera 171
Postelsia 748
Potato-stalk-borer 685
Potter's Wheel in Yucatan 511
Preissites wardii 844
Preller's Plistocene Deposits of Switzerland, Abstract of.... 664
Present Standing of the Florida Manatee *Trichechus latirostris* Harlan in the Indian River Waters, Outram Bangs 783
Preservation of Marine Animals. 399
Price, S. F. Queer Misfortunes of Birds 492
Prizes, Belgian Academy of Science, Letters and Fine Arts 697, 1047
Hodgskins Fund 1045
Problematical Structure in a Mammal 289
Proceeds American Microscopical Society 1894 927
Indiana Academy of Science for 1893, Review of 35
Scientific Societies 199, 402, 513, 600, 953, 1135
Prosser's Devonian System of Eastern Pennsylvania and New York, Abstract of 477
Protocaris marshii 983
Protochorda 681
Protolenus Fauna 839
Protomyxa 930
Protoptychus hatcherii 923
Protospongia 839
Pseudobrookite, Formula of.... 360
Pseudorectes 627
Psychidae 794
Psychology 74, 292, 388, 503, 687, 773, 873, 948, 1027, 1127
Psychology, Present State of... 292
Psychology of Sleep 1027
Pteropoda, Cambrian 983
Ptilopus iozonus 1059
nanus 1059
Ptilorhis magnifica 6
Ptychobothrium Lönnberg 53
Ptychodera australiensis 681
Ptychoparia 885
Ptychopariidae 839
Purcell's Eyes of Phalangiidae, Abstract of 177
Pygmornis longuemareus 862
Pyromorphite 838
Pythonomorpha 858
Pythonomorpha, Affinities of... 1004

QUARTZ-KERATOPHYRE from Wisconsin 473

RADIOLARIA, Cuban 844
Rana blanda 59
Rana esculenta 501
fusca 501
palustris 63
septentrionalis 147
Rangifer caribou 146
Ranke, J. Results of Cave Exploration in Germany 299
Ranunculaceae 748
Ranunculus alleghenensis 927
Reasia 1019
Recent Books and Pamphlets, 31, 140, 261, 353, 460, 560, 647, 732, 831, 919, 988, 1077
Recent Literature 34, 138, 258, 348, 459, 557, 650, 828, 916, 986, 1077
Rectes 416
arnensis 627
jobiensis 627
uropygialis 416
Redenbaugh, W. A. Preservation of Marine Animals...... 399
Redon's Experiments concerning Fatigue and Toxicity, Abstract of 1015
Reithrodontomys humilis dickinsonii 590
Relations of Devonian and Carboniferous Faunae 270
Renidi 359
Reports of the Geological Survey of Arkansas for 1891 & '92 266
Report on the Geology of Minnesota, Vol. III, Pt. 1, Paleontology, Review of 987
Reproduction of Plumularian Hydroids, C. C. Nutting.... 966
Reptilia 60, 172, 494
Reticulariaceae 932
Rhabdite 37
Rhoads, S. N. Additions to the Mammal Fauna of B. C..... 940
Description of a new Harvest Mouse from Florida... 589
Rhodoarsenian 655

Richard on the Gas in the Swim-bladder of Deep Sea Fishes, Abstract of........... 587
Richardia africana.................... 975
Riebeckite.............................. 997
Riley, Charles V., Obituary..... 959
Rob.rtson, C. The Philosophy of Flower Seasons, and the Phaenological Relations of the Entomophilous Fauna and the Anthophilus Insect Fauna............................... 97
"Rochester Rules," A Protest against................................. 666
Rock Classification.................. 997
Rock Differentiation..........656, 737
Rocks of Gouverneur, N. Y..... 994
Rock, sedimentary................... 740
volanic......................740, 1082
Rock-Volcanite........................ 153
Romanes' Post Darwinian Questions, Announcement of...... 1046
Rondletia................................ 376
Rondeletia bicolor..................... 281
Root Tubercles of Leguminosae E. F. Smith 898
Rope and Netting (Ancient) in Florida.................................. 695
Rostafinski 931
Rothert's Heliotropism, Abstract of, E. F. Smith........ 585
Schicksal der Cilien bein den Zoosporen der Phycomyceten, Abstract of, E. F. Smith................................ 583
Rothney, On Habits of Ants, Abstract of........................... 1019
Roule's Development of an Isopod, Abstract of.............. 180
Roux' Cytotropism in Frog's Eggs, Abstract of 385
Cytobropism in Cleavage Cells, Abstract of........ 511
Rules for Citation...... 373
Ruschenberger, William S. W. 405
Russell's Explorations in Northern Canada. C. C. Nutting. 45
Rutger's Use of Phosphorus in Studying Minerals of High Refractive Index, Abstract of 564
Ryder, John A........ 404
A Meeting in Memory of... 516
A New Method of Entrapping, Killing, Embedding and Orienting Infusoria and other very small Objects for the Microscope.... 194

SACCARDO'S Color Scale, Review of........................ 1009
Sala's Ascaris Eggs and Temperature, Abstract of......... 499
Salmon Fisheries of the Columbia River Basin................ 60
Sandals of Yucatan.................. 876
San José Scale........................ 685
Sand Mounds of the St. John's River, Florida. C. B. Moore 76
Sargent's Studies of the Forests of Japan. C. E. Bessey... 1049
Saurians, Extinction of........... 841
Sayre's Manual of Organic Materia Medica and Pharmacognosy, Review of......... 582
Scapanus dilatus........................ 61
Schists of Hoosac Mt............... 740
of Westchester Co., N. Y... 741
Schizocladium ramosum............ 968
Schreibersite............................ 37
Schultze's Double Monsters, Abstract of 287
Scientific News, 92, 200, 404, 514, 604, 695, 779, 959, 1040, 1137
Sciurus aberti concolor............... 61
Scierotinia aucupariae................ 749
padi...................................... 749
Scolioplanes 864
Scolithus................................. 884
Scott, S M. Discovery of Shell Mounds in Chira Valley, Peru...................................... 188
Scott, On a Geomyid from the Upper Eocene, Abstract of. 923
Scott's Affinities of Agriochaerus, Abstract of................ 368
Scudder's Insect Fauna of the Rhode Island Coal-Field, Abstract of 369
Ecyphomedusae, Development of.. 289
Sebastiania bilocularis................ 767
Seeds, Distribution of.............. 378
Seeliger's Sexually Produced Organisms Without Maternal Characters, Abstract of 286
Seleucides alba.......................... 4
Semioptera wallacei.................. 409
Serpierite..... 565
Sericulus aureus........ 411
Serpentines... 738
Serpentine Pseudomorphs....... 994
Rocks of San Francisco.... 41
Sexually Produced Organisms without Maternal Characters.................................. 286
Sexual Rights and Lefts. S. Garman 1012
Shastasaurus pacificus..... 844
Shell Mounds in Chira Valley, Peru. S. M. Scott........... 188
Siepert, On South American Volcanics, Abstract of... ... 996
Sight in Insects........................ 66
Significance of Anomalies. T. Dwight...................... 130
Silver Mines of Lake Valley, New Mexico. 661
Simpson, C. T. On the Validity

of the Genus Margaritana.. 336
Simpson's Geological History of the West Indies, Abstract of.......... 271
Simultaneous Origin of Similar (or identical) Varieties from different stock. W. W. Tracy 485
Siren lacertina.......... 54
Sjogrufvite.......... 655
Skertchly and Kingsmill on the Loess of Northern China. Abstract of.......... 478
Skunk a Source of Rabies. W. Wade.......... 242
Slingerland's Account of the Cabbage Root Maggot, *Phorbia brassicæ*, Abstract of. 495
Small's North American Polygonum, Review of.......... 747
Sminthus flavus.......... 61
Smith, E. F. Chalazogamy in *Jug ans regia*.......... 1103
Abstract of Beyerinck's Detection of Glukase by Auxanographic Methods.......... 752
Abstract of Bolton's Paper on Bactericidal Action of Metals.......... 933
Abstract of Englemann's Demonstration of Photosyntax by Bacteria.......... 750
Abstract of Kroeber's Transpiration Experiments 1011
Abstract of Moller's Mushroom Gardens of South American Ants.......... 851
Abstract of Woronin's Sclerotinia.......... 749
Review of Fischer's Bacteria.......... 847
Review of Macfarlane on Parameliotropiam.......... 1109
Review of Saccardo's Color Scale.......... 1000
Root Tubercle's of Leguminosae.......... 898
The Symbiosis of Stock and Graft.......... 615
Smith's Faunal Migrations, Abstract of.......... 922
Geology of the Costal Plain of Alabama.......... 259
Smyth's Dykes of the Thousand Islands, Abstract of.......... 472
Gabbro of the Adirondacks, Abstract of.......... 471
Snakes, North American.......... 676
Observed at Raleigh, N. C. C. S. Brimley.......... 56
Sobotta, On the Fertilization and Cleavage of the Mouse Egg, Abstract of.......... 770
Specimens, Archeological and Geological, from Avery's Island.......... 394
Spelerpes bilineatus.......... 55
longicaudus.......... 55
maculicaudus.......... 55
Spemann, On Eggs of Nematodes, Abstract of.......... 945
Spencer, J. W. Recent Elevation of New England.......... 1007
Review of Howarth's Glacial Nightmare and the Flood.......... 830
Sphaerechinus granularis.......... 286
Sphecotheres salvadori.......... 630
Spiders, Web-Spinning.......... 490
Spiranthes aestivalis.......... 974
praecox.......... 973
Spirostrephon.......... 1017
Spondylus americanus.......... 760
princeps.......... 192
Sponges..........538, 839
Recent and Fossil. J. F. James.......... 536
Spongillidae from Ireland.......... 854
Sporozoa.......... 931
Staphylococcus pyogenes aureus.934, 935
State Academies of Science.......... 136
Staurolite, Formula of.......... 361
Stedman, J. M. Observations on a So-called Petrified Man 326
Stemmatoiuloidea.......... 1112
Stemmatoilus as an Ordinal Type. O. Cook.......... 1111
Stemmatoiulus bellus.......... 1116
calvus.......... 1119
pencilllatus.......... 1116
Stemonitaceae.......... 932
Stiles, C. W. The Species of Bothriocephalus.......... 53
Stimuli in Embryology.......... 502
Stridulating Organ.......... 1020
Strizamia.......... 864
Strongylus paradoxus.......... 945
tetracanthus.......... 931
Stubbs, J. A. Baboon Switch-Tender.......... 875
Syenites, Greenland.......... 839
Syringophilus bipectinatus.......... 682
uncinatus.......... 684
Systematic Botany of the United States.......... 164
Systrurus Garman.......... 284
Successive, Protandric and Proterogynic Hermaphroditism in Animals. T. H. Montgomery, Jr.......... 528
Swallows.......... 1031
Roost at Waterville, Maine 377
Symbiosis of Stock and Graft. E. F. Smith.......... 615

T*ACHARDIA cornuta*.......... 728
Taleopoidæ.......... 794
Talegallus cuvierii.......... 1062
fuscirostris.......... 1063
jobinensis.......... 1063
Tamais quadrivittatus felix.......... 941

Tarns of Lakeland, England.... 477
Taylor, W. E. Preliminary Notes on the Osteology of the North American Crotalidæ.... 281
On Box Tortoises, Review of, E. D. Cope.... 756
Taylor's Niagara and the Great Lakes, Abstract of.... 570
Temperature and Development 288
Tephrite.... 997
Terebra fulgurata.... 192
Terraces of the Connecticut River.... 579
Terrapene baurii.... 756
carolina.... 757
major.... 757
mexicana.... 757
ornata.... 757
triunguis.... 757
Tertiary Rhynchophorus Coleoptera of the United States.. 138
Tettix granulatus.... 761
incurvatus.... 761
Tetragonopterus.... 760
Thirteenth Annual Report of the U. S. Geological, Survey for 1891–'92.... 259
Tracey. W. W. Simultaneous Origin of Similar (or identical) Varieties from different Stock.... 485
Transpiration Experiments.... 1011
Traumatropic Curvature of Roots.... 927
Trelease, W. Facilities for Research at the Missouri Botanical Gardens.... 668
Triarthrus, Structure of.... 475
Trichechus latirostris Harlan.... 783
Trichiaceæ.... 932
Trilobita.... 839
Trilobites, Cambrian.... 984
Trinucleus concentricus.... 578
Triton alpestris.... 947
Trivia radians.... 192
Trouessart, E. L. Criticism of Hancock's "A New Trombidian.".... 682
Tubulinaceæ.... 932
Tuburcinia trientalis.... 749
Tuffs, South Harz.... 1082
Tutton's Instrument for Producing Monochromatic Light of any Wave Length.... 991
Instrument for Preparing accurately Oriented Sections and Prisms from Crystals.... 990
On Connection between Atomic Weight of Contained Metals and Morphological and Optical Properties of Crystals, Abstract of 835
Tutt's Rambles in Alpine Valleys, Review of.... 916
Twins, Origin of.... 686

UINTA Rodent.... 923
Uma inornata.... 939
notata.... 939
rufopunctata.... 939
scoparia.... 938
Unio pressus.... 338
lachrymosus.... 341
Upham, W. Minor Time Divisions of the Ice Age.... 235
Use of Parasitic and Predaceous Insects.... 69

VALIDITY of the Genus Margaritana, C. T. Simpson.... 336
Van Gehuchten's Central Nervous System of Teleosts, Abstract of.... 278
Norden's Psychic Factor, Review of.... 874
Variation of Crystal Angles.... 653
in *Halicystus octoradiatus*.... 1104
Vermes.... 58
Vegetable Physiology, 583, 671, 749, 847, 933, 1009.... 1101
Vegetation of Nebraska.... 487
Vermes, preservation of.... 400
Vespertilio lucifugus.... 860
nitidus.... 860
subulatus.... 860
Vespertilio subulatus keenii.... 860
Venturia chlorospora f. mali.... 584
Vicinal Planes.... 653
Vienna Propositions.... 1093
Vinsonia stellifera.... 727
Volcanic Rocks of Maine.... 1082
Volcanoes, African.... 264

WADE, W. The Skunk as a Source of Rabies.... 242
Ward's Action of Light on Bacteria, Abstract of.... 671
Washington's Petrography of Aegina and Methana, Abstract of.... 658
Web spinning of Spiders, Origin and Evolution of.... 490
Webber, H. J. Distribution of Seed by Birds.... 378
Weed, C. M. Entomology at Springfield.... 942
Review of Comstock's Manual for the Study of Insects, 649
Review of Scudder's Frail Children of the Air.... 1076
Weed's Ten New England Blossoms and their Insect Visitors, Review of.... 918
Weed and Pierson's Example of Rock Differentiation, Abstract of.... 737
Weinschenck's Serpentines of the Central Alps, Abstract

of 738
Weir, J. Jr. The Effect of Female Suffrage on Posterity 815
Well-borings in Iowa 844
West Indies, Geological History of, Abstract of 271
Wethered's Theory of the Formation of Oolite, Abstract of 840
Weysse' Problematical Structure in a Mammal, Abstract of 289
Wickham, H. F. On the Early Stages of some Carabidæ and Chrysomelidæ 762
Wickham on the Spread of *Otiorhyncus ovatus*, Abstract of 177
Whale Bone Whales, Phylogeny of 572
White Headed Eagle 168
River Dinictis 573
River Fossil Mammals 272
White's New Molluscan Forms from the Dakota Formation, Abstract of 159
Will and Reason in Animals, W. R. Newbold 948
Wild Flowers of America, Review of 49
Williams, T. A. Notes on Mexican Lichens 480
Relations of Devonian and Carboniferous Faunæ, Ab-Abstract of 270
Williamson B. Aestivation of Snails in Southern California 1107
Willis' Practical Flora, Review of 50
Williston. On the Irrigation of Western Kansas, Abstract of 664
Willyanite 151
Wilson's Atlas of Karyokinesis, Review of 1075
Wilson, T. Paleolithic Man in North America 599
On the Presence of Fluorine as a Test for the Fossilization of Animal Bones 301, ... 439, 719
On the Reproduction of the Edible Crab, Abstract of 854
Wolff's Diamond Saw 991
Woronin. On Sclerotina, Abstract of 749
Wright, G. F. Evidence of Glacial Man in Ohio 951

X*ANTHOMELUS aureus* 412
Xantusia 758
Xantusia picta 939
Xantusiidæ 757

Y*UCCA aloifolia* 927
Yucatan, Notes on 507

Z*AMENIS conirostris* 79
lateralis fulginosus 679
stejnegerianus 678
Zablepsis 758
Zeuglodon cetoides 745
Zeugopterus punctatus 60
Zeuzera pyrina 175
Zimanyi's Determination of the Principal Indices for the most Important Rock-making Minerals, Abstract of 654
Zinc Deposits of Missouri 916
Oxide 149
Zoja's Blastomeres of Medusæ, Abstract of 290
Zoology, 52, 167, 278, 376, 490, 583, 674, 753, 854, 936, ... 1011
Zoological Explorations in the far North 45
News, 58, 171, 285, 380, 493, 680, 760, 862, 942, ... 1110
Zygænidæ 799
Zygæna scabiosæ 553
Zygomaturus 580

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CONTENTS.

PAGE.

BIRDS OF NEW GUINEA. (Illustrated.) *George S. Mead.* 1

LEUCISCUS BALTEATUS (RICHARDSON), A STUDY IN VARIATION. (Illustrated.) *Carl H. Eigenmann.* 10

ON THE EVOLUTION OF THE ART OF WORKING IN STONE. *J. D. McGuire.* 26

RECENT BOOKS AND PAMPHLETS. 31

RECENT LITERATURE—Packard on the Inheritance of Acquired Characters—Proceedings of the Indiana Academy of Science for 1893. 34

GENERAL NOTES.

Mineralogy—Identity of Rhabdite and Schreibersite—English's New Catalogue of Minerals—Leadhillite from near Granby, Missouri—Two New Instruments for Mineral Study—Miscellaneous Notes. 37

Petrography—The Serpentines of San Francisco—The Blue Hornblende in the California Schists—The Diorites, Gabbros and Amphibolites of Argentina—Amphiboles in Russian Rocks—Basalt Boulders from Thetford, Vt.—Maryland Granites. 41

Geography and Travels—Zoological Explorations in the Far North. 45

Botany—The Wild Flowers of America—Willis' Practical Flora 49

Zoology—The Sensory Canal System of Chondrosteans—The Hypophysis—The Species of Bothriocephalus—Batrachia of Vincennes, Indiana—List of Snakes Observed at Raleigh, N. C.—An Abnormal Pes of Columbia livia (Illustrated.)—Zoological News. 52

Embryology—Optimum Temperature for Incubation—Cell Lineage—Fertilization in the Earthworm—Cleavage in Batrachia—Development of Sponges. 62

Entomology—Sight in Insects—Origin of Reproductive Cells in Insects—Alimentary Canal in Orthoptera—North American Jassoidea—The Use of Parasitic and Predaceous Insects—Oviposition in Acridiidæ—The Use of Chinch Bug Diseases. 66

Psychology—The Burrowing Habits of Snakes—Habits of Heterodon platyrhinus at Raleigh, N. C. 74

Archeology and Ethnology—Certain Sand Mounds of the St. John's River, Florida by Clarence B. Moore. 76

Microscopy—Formal as a Preserving Fluid. . 82

SCIENTIFIC NEWS. 92

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BIRDS OF NEW GUINEA.

By Geo. S. Mead.

(Continued from Vol. XXVIII, p. 920.)

The Magnificent bird of paradise—*Diphyllodes magnifica* or *speciosa*, is as appropriately named as any of the *Paradisea*, since the qualifying adjectives are scarcely more than mere epithets, with nothing specially discriptive or distinctive about them. In the Magnificent we find an adornment not unlike that which beautifies the Superb, viz. a mantle or fringe of bright yellow feathers over an inch long, rising from the back of the neck. The bird is still further characterized by the long filaments noted in the Red and other members of the family. These feathers in the Magnificent curve into a double circle, differing, therefore, in shape from those of his cousins. A darker yellow than the mantle appears on the body above; this colour of course lights up or deepens with the play of light upon it, just as does also "the rich green flushed with purple" of the parts underneath, so that when the full, expanded plumage is displayed, the radiant little creature will be seen to possess every claim to his title. The under or secondary mantle, whence the generic name, rich and warm in color, sets off still more the novel charms of the bird. In size he is one of the smallest of his race, being but little larger than the King.

Another bird of paradise is not inaptly called the Incomparable, for it is wondrously attired, yet this designation too might as fittingly to bestowed upon almost any species where each is conspicuous for some particular charm. But in one respect at least this paragon (*Paradisea gularis*) presents a decided contrast to other *genera*—in the structure or appearance of the tail. In place of long floating plumes or bewildering maze of drooping feathers with the wire filaments projecting far beyond, there are true tail-feathers much prolonged and broadening somewhat toward the extremities. As a further mark of distinction in addition to the disproportionately long and peculiarly shaped tail, the Incomparable bears on its head a double crest of velvety feathers which flash and glitter, requiring only the light to bring out all the colours from their dull depths. The same may be said of the scales of copper and gold on the throat and breast. Equally gorgeous though without the scintillating reflections is the glossy apparel of the body and tail. The whole plumage in fact "glows with an effulgence of varied hues that almost baffle description."

To support this wealth of colour and feathers nature has furnished a pair of strong, substantial legs, very serviceable indeed for grasping branches of trees, but far from shapely. Large, ugly feet and legs, however, are the common heritage of all the birds of paradise, the only parts visible where the useful has predominated over the ornamental. This is eminently true of *Paradisea apoda* whose descriptive, scientific appellation is decidedly a misnomer. Let us not, however, now that we are convinced that *Apoda has* legs, cast the term aside, for the pretty fiction it commemorates is worth retaining. This lovely bird is almost too well known to require more than a brief notice. It was the first of its kind to become a familiar and admired object in museums as it had long been an article of commerce. This fact may have arisen partly from its abundance, its supreme beauty or the accessibility of the regions it inhabited. The specimens we see in cabinets, well mounted as they often are and carefully preserved, are dim and lustreless beside the living creatures as they flash in all the

splendor of vivid colours amid their native haunts. Here the foliaceous snow-white plumes waving in the wind, the buoyant pinions dark of hue, the brown-golden plush of the body, the violet and purple breast, the dazzling yellow of neck and head, the changing metallic green of the throat all form a picture that once seen is never forgotten. Of reduced size and of somewhat paler colors, but in other respects almost the counterpart of the *Apoda*—or Great, Common, Emerald, as it is variously called, is the Lesser bird of paradise—*Paradisea minor* or *papuana.* These two species stand in about the same relation to each another as the hairy and downy woodpeckers of our forests.

In his first visit to New Guinea in 1871, D'Albertis killed the male of a bird which is labelled in his interesting work "new genus and new species." Mr. Sclater denominated it *Drepanornis albertisii.* It certainly is very different in appearance, especially in the form of the beak, as D'Albertis points out, from other species of birds of paradise. "The beak resembles that of the hoopœ," being long and curved. The plumage lacks the velvet-like texture of other species, but is downy, while the head, although crested with curious protuberances of small feathers gleaming green and copper in certain lights, is not similar in shape. Nor can it be placed on an equality with its fellows in that beauty and arrangement of plumage we think of as typical of birds of paradise. And yet its claims are not to be slighted; its rich umber coat shines with lustre; tufts of feathers, beautifully tinted and so long as to almost enfold the body, spring from the breast and sides, and the dividing colors seem to stand out, so vivid and distinct are they. Whether open or shut the two semicircular feather-fans or shoulder-crests gleam in the light like a humming-bird's array; the same may be said of the throat and breast. Purple, violet, yellow, brown and gold, are some of the hues that chase each another over the soft plumage. The under parts from the breast to the rounded tail which is unadorned with loose plumes or elongations, are white; a roseate tinge may be seen on the spurious wings, while greyish and olive reflections appear on the edgings of both the long and short feathers. The

long, curving bill continued from a small somewhat flattened head, suggest habits akin to the sun or honey birds, and even relationship to them. The above is also called *Epimachus vethii*, vide p. 393, Vol. 28, no. 329 of Amer. Nat.

Mr. Denton, whose keenness of observation is evident in his interesting volume of personal experience as it is also in his recollection, and whose ready assistance one takes pleasure in acknowledging, likens the head of *Drepanornis* when the feathers are puffed out to that of the crested grebe. He regards it as one of the oddest, strangest and most grotesque-looking of birds.

Whether the so-called Plume birds form a distinct family as some naturalists have divided them or whether they should be ranked among the birds of paradise as merely a long billed variation—a species to which the *Drepanornis* should properly belong, certain it is that there is nothing lovelier in feathers to entitle their possessors to a classification with the peerless *Paradisea.* This much as to their appearance; as to their diet, they are both insectivorous and frugivorous feeding largely upon the fruit of the pandanus tree. The legs and feet are almost misshapen, naked along the thighs and livid in colour. The cry is long and cadenced. In essaying a description of these birds it is well to keep in mind the words Mr. Wood used in his own account. In speaking of the inadequacy of language to convey the impression the changing beauty of the plumage leaves upon the mind, he adds: "even with the assistance of colour, any idea that can be given, would necessarily be very imperfect, and the most admirable illustrations ever drawn, rich in ultramarine, carmine, and gold, would 'pale their ineffectual fires' even before the stiff and distorted form of the stuffed bird. The very respiration keeps the feathers in continued motion, causing them to change their tints with every breath, etc. This is in itself a description. In additional respects the species under consideration—the twelve-wired *Epimachus, Seleucides alba* of D'Albertis, is enshrouded in soft, loose plumage, like velvet to look upon and of the richest tone. It is a beautiful puzzle in arrangement and coloring, a poem in feathers, a symphony in the interfu-

sion of a few tints only, which might almost be reduced to mere lustrous black and orange: the body being dark of hue, while beyond and enveloping the short tail, delicate creamy-yellow plumes extend in a bewildering maze. "The bird is so gorgeous," exclaims D'Albertis, "that it is not surpassed by any other of the feathered tribe." Its distinguishing feature, unique among birds, is the display of wire feathers—six on a side, threading the intricacy of the waving plumes and prolonged several inches. These are much attenuated, black in colour and without the terminal web. They cannot be said to add materially to the beauty of the bird though they certainly do to its singular appearance. Far more attractive from an aesthetic point of view, are the recurved feathers standing out from and partly encircling the neck. These reflect from their burnished surface all flashing colours, blazing in sunlight like polished gems. D'Albertis observed that the tail of the female and young males was long in proportion to the body. There is, however, one of this interesting group of birds, the adult male of which is furnished with a tail remarkable for its excessive length; this is the *Superb epimachus—Epimachus magnus* or Long-tailed bird of paradise. Mr. Denton in his Incidents of a Collector's Rambles thus summarizes its charms:—"The plumage is a velvety-purple-black; the tail is two feet long; and the side plumes have a bar of the most exquisite green and gold, extending across the tips." In this example the coloration is even simpler than in the foregoing, that is, the ground or primitive tint is black, lustrous black, but the effect of light upon this basal colour is quite as marvellous as in any bird specimen. The play becomes always different and incessant. The black seems both suffused and shot over with emerald, turquoise, bronze, yellow, every hue you please, and this not only from the metallic surface of the wings and tail but from the soft, dark velvet of the body, as well. There is a similar collar or ruff around the neck of the Superb, as adorns the twelve-wired bird; but the tail is altogether different. Instead of the pendulous plumes which may answer for caudal ornamentation we find twelve long-extended quill feathers, the two longest in the middle, sometimes cross-

ing each other at their extremities, the lateral feathers decreasing gradually in length towards the rump. These glow with colour of a brilliancy almost equalling that reflected from the shining throat and breast. Altogether this Plume bird is a splendid representative of its race, not only in respect to its exquisite shape and coloring, but also great size, for it can boast of a total length of nearly four feet. When the mantle is uplifted, there is plainly discernible a lovely wavering crescent of blue light about an inch from the edges and reaching as far as the body. Mr. Wallace describes these broad side-plumes as dilated at their extremities; rather do they seem as if a pair of shears had clipped them before they had become fringed. Nor can it be said that the bar of quivering color extends along the tips; this must be removed as has been stated, a little space below, where, if so chameleon-like a tint can be labelled, it is a glowing azure.

When Mr. John Gould, the author of Birds of Australia and other monumental works, was at work in the Island-continent, he limited the range of the Rifle Birds to one small section of that country. Recent travellers, however, in New Guinea have found members of this interesting group there also. Mr. Octavius Stone who spent "a Few Months in New Guinea" collected the *Ptilorhis magnifica* along the southern coast, and Mr. S. F. Denton gives an engaging description of his pursuit and capture of the same. This bird is not enriched with the feathered efflorescence, if we may so term it, to the same extent as the Plume-birds to which it is allied, and the birds of paradise, but the sheen of its scale-plumage is of even greater intensity. Colours flash from head and throat with gem-like rapidity and effulgence, for these parts are covered, as it were, with bits of glittering steel that are emerald-green to look upon when the bird is perfectly still, but when a movement is made there is a sudden blaze of yellow mingled with the primal tints.

The rest of the body is of a velvety black "touched here and there with purple gleams of light." Mr. Denton calls it "one of the loveliest and richest creatures" in the world. Its note he says, is a loud and coarse croak and when it flies "every stroke of its wings squeak as if two pieces of crisp silk had been

rubbed together." The point of resemblance between the *Pliloris* and *Epimachus* is the long, curved beak. In other respects there is a marked contrast. The plumage in the former is mainly compact, and, divested of its glancing hues, is characterized by its simplicity. The tail too is not developed into a long or spreading train but is short, stout and square, serving apparently the useful purpose of a prop or assistance to the bird as it climbs on branches of trees, for its likeness to the Creepers has already been pointed out, though its large size assorts oddly with their slender frames. It is, however, not entirely without side plumes, but these are thin and scant and reach underneath scarcely beyond the tail when the wings are closed. The croak of this bird is absolutely appalling in its loudness, volume and dissonance; it may be heard half a mile or more and when once heard is never forgotten. He is strangely local in his habitat and whatever spot he has appropriated as his peculiar domain, he cannot be driven away from, nor does he endure a trespasser upon it.

There are several more species of the *Paradisea* or kindred forms yet to be described, but further consideration of them will be deferred to another occasion. Probably others are still to be discovered, and it may be, as has been asserted, that as many as forty distinct varieties of these unrivalled creatures await the admiration and wonder invariably paid them. But on the subject of the irrelevancy of man to the animate beauties of nature, some reflections of Mr. Wallace, in connection with his first sight of the King-bird of paradise, may profitably be studied.

It is needless to say that the foregoing descriptions refer in every instance to the male bird. The female, as is invariably the rule with brilliantly plumaged birds, is comparatively plain, positively so in the case of the Rifle-bird where the dullest shade of brown emitting no sparkle whatever is all that nature has allotted. She is not even graced with the two bright-green middle tail feathers which shine so conspicuously amid the dark-toned velvet of the male bird. Yet there are some examples of elegance of form and loveliness of plumage that, whether their possessors are merely paler reflections of their

mates or may be guaged on their own merits, can claim high rank in the lists of beauty. Such are, to mention two or three only, the Great and Lesser birds of paradise. It is only in the dazzling présence of their lords that the charms of the females seem dim and unimportant.

But little that is exact and trustworthy is known of the habits, modification and general life of birds of paradise. They keep to the tallest trees as a rule, with the exception of the little King-bird and the Magnificent, who favor bushes and small growths. Although not particularly suspicious they resent intrusion on their haunts, retiring out of sight quickly or screaming in vociferous tones their uneasiness. They do not, however, by any means reserve their discordant cries for occasions of alarm, but are indefatigable in uttering them at other times as well, yet a singularly sweet note heard now and then in the dense forest is accredited to one or another of the paradise-birds. From the Magnificent for instance proceeds a squirrel-like chatter that may be imitated by sucking the back of the hand rapidly. *Raggiana* too is said to make a peculiar whistle as when a man calls his dog.

At periods of mating these birds are nosiy and clamorous. It is then that the natives undertake their capture at the time when those remarkable courting-dances or displays are in progress, wherein the male, oblivious to everything but the object of his desire, is thrown into a frenzy of passion, attitudinizes in every conceivable posture and spreads out all the glories of his splendid plumage. The silent deadly blow-gun is now brought into requisition with telling effect, bird after bird falling in the interests of trade. As the *Paradisea* are by no means solitary, but, where they are met with at all, fond of associating together in small flocks, it can easily be perceived how large a supply is annually furnished to the exigencies of commerce. But this murder of the innocents, one may be glad to remember, is after all limited to a few species, for, as it has already been intimated, the majority of the different varieties are never exported—natural obstacles, scarcity of numbers or lack of demand effectually preventing.

The fruits of the teak-wood, the pandanus, etc., constitute perhaps the larger portion of the food of these birds, but their grosser appetite does not disdain an insect diet---beetles, certain kinds of bugs and locusts, not forgetting frogs, lizards and other small reptiles with which the New Guinea forests are well stocked. If one would prefer that these ethereal creatures lived upon things less obnoxious to our tastes, he may console himself with the knowledge that they occasionally partake of butterflies, which in these wilds are, in many cases, almost as lovely and aerial as the birds themselves. It is doubtful, however, if these are taken on the wing as some have fancied; the expanding plumage would seem to forbid any such attempt on the part of the pursuer even though the prey be only a slow-sailing *Lepidopter*. *Seleucides alba* is said to sip the nectar from flowers.

Of the nests, eggs and young but little is yet known although it would seem as if opportunities for such knowledge, had not been altogether lacking.

> "What character,
> O sovereign Nature! I appeal to thee,
> Of all thy feathered progeny
> Is so unearthly, and what shape so fair?
> So richly decked in variegated down,
> Green, sable, shining yellow, shadowy brown,
> Tints softly with each other blended,
> Hues doubtfully begun and ended;
> Or intershooting, and to sight
> Lost and recovered, as the rays of light
> Glance on the conscious plumes touched here and there"?
> Bird of Paradise.
>
> —*Wordsworth.*

A colored plate of the *Drepanornis albertisii* will appear in the next number of the Naturalist.

LEUCISCUS BALTEATUS (RICHARDSON), A STUDY IN VARIATION.[1]

By Carl H. Eigenmann.

Nowhere else in North America do we find, within a limited region, such extensive variations among freshwater fishes as on the Pacific slope. This is true, whether we have reference to the extent of variation between the extremes of the same family or to the limits of variation in any given species.

A comparison of the members of the eight families of fishes having representatives on both the Atlantic and Pacific slopes, show that, on an average, each of these families has four genera and sixteen species on the Pacific slope, and seven genera and thirty-six species on the Atlantic. Yet, although the number of species is more than twice as great on the Atlantic slope, the variation in the number of fin rays among the Pacific slope species is greater in all but two families. I have recently[2] made a detailed comparison between the members of the different families, and there attributed this great extent of variation to two causes. First: the fauna is of diverse origin; some of the members are of Asiatic, while others are of Atlantic descent. Second: the fauna is new as compared with the Atlantic slope fauna, and has not yet reached a stage of stable equilibrium. It is possible, as suggested to me by President Jordan, that the Pacific slope fauna has retained its primitive charactèrs more nearly than the Atlantic slope fauna, which shows signs of degeneration in its fins and teeth.

This great variation between the members of the same families is not confined to the fin rays. It is equally true of other characters, but can best be demonstrated in characters whose variation can be numerically expressed. The pharyngeal

[1] Contributions from the Zoological Laboratory of the Indiana University, No. 11.

[2] Results of Explorations in Western Canada and the Northwestern United States. Bull. U. S. Fish Com. for 1894, pp. 101 to 132. Plates 5 to 8. June, 1894.

teeth of the Cyprinidæ offer another striking example of these variations among the Pacific slope species. In a number of cases, the variations of the Pacific slope species extend along definite and parallel lines. I have pointed out some of these in the paper quoted above. These lines are directed towards an increase of rays and towards a modification of rays into spines.

The following quotations, from Gilbert and Evermann's recent work on the Columbia River Basin,[3] illustrate the variation among the different specimens of the same species. "The range of variation seems to be very great, and characters which are of undoubted specific value when applied to Atlantic drainage species, do not possess any such value for classification of Pacific coast fishes. Each so-called species seems to be in a very unstable state of equilibrium, and not to have yet assumed or been able to retain, with any degree of permanence, any set of specific characters." "The crosswise series of scales [in *Agosia nubila* (Girard)] varies from 47 to 70 in number; the barbel [a generic character] is present or absent; the pharyngeal teeth vary from 1,4–4,0 to 2,4–4,1; and the dorsal fin varies much in position and somewhat in size. These characters occur in various combinations, and with some of these are often correlated peculiarities of physiognomy and general appearance, all of which may serve to put a certain stamp upon the individuals from a single stream, or even from one locality in a stream." These observations, especially those contained in the last sentence, accord exactly with the results obtained by me in Leuciscus, and confirm my statement which will be further reënforced by the present paper, "that each locality has a variety which, in the aggregate, is different from the variety of every other locality."

The remarkable variation of the Pacific slope species, and more especially the variation in the fin rays, was first noted in preparing my account of the specimens collected in the Colum-

[3] Report of the Commisssioner of Fish and Fisheries on Investigations in the Columbia River Basin in Regard to the Salmon Fisheries. Washington, 1894. A report upon investigations in the Columbia River Basin, with description of four new species of fishes.

bia and Frazer Basins.[4] This variation was most pronounced in the species of the late genus Richardsonius. Of the species of this genus, I had about 250 specimens, collected in the Frazer and Columbia systems, from tidewater to an elevation of 2,786 feet. The later explorations of Gilbert and Evermann have increased this number to 825, and these warrant a re-examination of the points stated by me. For all the data concerning the fin rays of the specimens collected by Gilbert and Evermann, I am indebted to them. Their examination of these specimens was made to test certain conclusions reached by me, and their data, therefore, join mine. In counting the anal rays, I counted the rudiments at the beginning of the fin. These were not counted by Gilbert and Evermann, and to bring their data in perfect accord with mine, it is necessary to add 2 to the number of anal rays. While the number of rudimentary rays is not always 2, it is so often that the exceptions would probably not alter the general results.

At the time I began my studies of these forms, they were regarded as two species, forming a peculiar genus, Richardsonius. They were known to inhabit the Columbia River and the streams about Puget Sound. The compressed belly behind the ventral fins was regarded as the character separating them generically from the related forms. It soon became evident that, while some specimens possessed this, if constant, unquestionable generic character, others did not show it at all, and the genus was relegated to the limbo of synonymy. The species *balteatus* and *lateralis* were distinguished as follows:

a. Base of anal, 4¼ in the length; A. 17 or 18; teeth, 2,5–4,2. Lower jaw slightly projecting beyond the upper. Coloration plain; the sides bright silvery; crimson in males in spring. Scales 13–62–6. *balteatus.*

aa. Base of anal 5⅓ in the length; A. 14; teeth 2,5–5,2. Jaws equal; blackish above; a dark lateral band; the interspaces and belly pale; crimson in male in summer. Scales 13–55–6. *lateralis.*

[4] This variation in the same species does not seem to be confined to the Fishes. Prof. Ritter, Proc. Cal. Acad. Sci., 2d Ser., Vol. IV, p. 37, finds the same in *Perophora annectens,* a new tunicate described by him.

No better distinguishing marks could be wished by any systematist. These characters were found to be so bridged, that the extremes could not be specifically sustained, and one of them, probably out of deference to the authority of my friends Jordan and Gilbert, from whom the above diagnosis was modified, was retained as a variety of the other. Now I am inclined to regard *lateralis* as a synonym of *balteatus* with Gilbert and Evermann, but I must take exception to the statement attributed to me that I "considered *lateralis* a subspecies of *balteatus* occupying the same brook with its parent form." I found *balteatus* at the lower Frazer to Kamloops, *lateralis* at the headwaters of the Thomson River down to Kamloops. I see no reason why a subspecies should not occupy the same "brook" with its parent form, for some allied species—between which and subspecies there is, after all, but a mental difference—are, even by Gilbert and Evermann, admitted to live side by side (*Agosia falcata* and *umatilla* at *Umatilla*).

Leuciscus balteatus ascends the tributaries of the Frazer and Columbia as high as the falls will permit. No other species is found in the Frazer system nor in the Columbia Basin proper. The specimens from Brown Gulch were described as different from those of the lower Columbia, but a comparison of large numbers from other localities has shown them to be but one of the numerous local variations. Three other species, *L. hydrophlox*, *lineatus* and *aliciæ*, are found in the Snake above the falls. The last two belong to a different section of the genus *Leuciscus*, and are not closely related to the *balteatus*. All three have probably entered the Snake River from the Utah Basin. As far as known, the territories of *L. balteatus* and *hydrophlox* do not overlap, unless those specimens of *balteatus*, with only 13 or 14 anal rays, are, in reality, *hydrophlox*, and, as far as my experience goes, the number of anal rays is the only ready means of distinguishing the two. *L. balteatus* extends up to or near to the first falls of the Snake, *hydrophlox* is found from this point to the headwaters. A comparison of *hydrophlox*, *balteatus* and *gilli*, the specimens from Brown's Gulch, makes it quite certain that they are all modifications of the same form.

Below are given a number of tables which show the variation in several characters. These tables are all from my own specimens.

From these tables it will be noticed that the number of dorsal rays is quite constant, being from 10 to 13. The variation

TABLE OF VARIATION FOR 26 SPECIMENS FROM MISSION.

No.	Length in mm.	Dorsal.	Anal.	Scales.	Teeth.*	Depth.	Position of dorsal.	Sex	Remarks.
1	140	13½	18½	12–59–6	....	3 1-2	(†)	♀	Keel scarcely evident.
2	120	12½	21½	11–53–5	‡2, 5–4, 1	3 2-5	(§)	♂	Median keel scarcely evident.
3	110	13½	19½	12–60–6	2, 5–4, 2	3 2-5	(‖)	♂	Median keel moderate.
4	105	12½	20½	12–58–6	2, 5–4, 2	3 1-4	(‖)	♀	Median keel well developed.
5	100	12½	19½	11–57–6	2, 4–4, 2	3 2-5	(†)	♂	Keel typical.
6	102	12½	18½	12–60–6	2, 5–4, 2	3 1-2	(§)	♂	Keel moderate.
7	91	11½	20½	12–57–5	2, 4–3, 1	3 3-7	(‖)	♀	Keel evident.
8	92	11½	19½	12–58–6	2, 5–4, 1	3 3-5	(‖)	......	Keel distinct.
9	88	12½	19½	12–61–6	2, 5–4, 2	3 2-3	(‖)	♂	Keel well developed.
10	92	12½	21½	12–63–6	2, 5–4, 1	3 7-8	(§)	♀	Keel typical.
11	102	12½	20½	11–62–6	2, 5–4, 2	3 3-5	(§)	♂	Keel well developed.
12	87	12½	20½	13–59–6	1, 5–4, 2	3 3-5	(†)	♂	Keel moderate.
13	86	12½	20½	11–59–7	2, 5–4, 1	3 1-4	(‖)	♂	Keel well developed.
14	83	12½	20½	12–61–7	2, 5–4, 1	3 1-2	(†)	♂	Keel no more than in *montanus*.
15	80	11½	19½	12–61–6	2, 5–4, 1	3 3-5	(†)	♂	Keel distinct.
16	95	12½	18½	13–59–7	2, 5–4, 2	3 1-2	(‖)	♂	Keel evident.
17	90	12½	17½	13–58–7	2, 5–4, 2	3 2-3	(†)	?	Keel moderate.
18	80	11½	17½	11–60–7	2, 5–4, 2	3 1-2	(†)	♂	Keel typical.
19	77	12½	17½	57	2, 5–4, 2	3 4-5	(†)	?	Keel well developed.
20	87	12½	16½	13–61–7	2, 5–3, 2	3 2-3	(§)	.....	Do.
21	81	12½	22½	12–58–7	2, 5–4, 2	3 2-3	(‖)	♀	Keel moderate.
22	80	13½	21½	61	2, 5–?	3 4-5	(‖)	♀	Do.
23	74	11½	16½	....	2, 5–4, 2	....	....	.....	Do.
24	60	13½	24½	....	2‘ 5–4, 2	3 4-5	†	.....	Keel evident.
25	68	13½	24½	....	....	....	....	.....	
26	64	12½	23½	....	....	....	....	.....	

* I have frequently observed that the largest individuals among the minnows usually have abnormal numbers of teeth.

† Equidistant from base of middle caudal rays and a point above middle of pupil.

‡ Anterior tooth of main row on left side is large, dagger-shaped, and remote from the others, and points inward.

§ Equidistant from base of middle caudal rays and upper angle of preopercle.

‖ Equidistant from base of middle caudal rays and posterior margin of eye.

TABLE OF VARIATION FOR 8 SPECIMENS FROM SICAMOUS.

No.	Length	Dorsal.	Anal.	Scales.	Teeth.	Depth.	Position of dorsal.	Sex	Remarks.
	mm.								
1	82	12½	19½	11–60–6	2, 4–3, 1	4—	(*)		
2	92	12½	16½	11–62–6	2, 5–4, 2	....	(*)		Keel indistinct.
3	90	12½	14½	14–62–7	2, 5–4, 2	3 3-5	(†)		
4	87	12½	17½	12–60–5	2, 5–4	4	....		
5	85	12½	16½	10–62–5	2, 5–5, 3	4 1-5	(‡)		
6	80	12½	18½	11–60–6	2, 5–4, 1	4 1-4	(*)		
7	85	12½	16½	11–59–5	2, 5–4, 2	4	(†)		
8	77	12½	17½	11–61	2, 5–4, 1	4 1-5	(*)		

* Equidistant from base of middle caudal rays and upper angle of preopercle.

† Equidistant from base of middle caudal rays and a point above middle of pupil.

‡ Equidistant from base of middle caudal rays and occiput.

TABLE OF VARIATION FOR 18 SPECIMENS FROM THE COLUMBIA AT GOLDEN.

No.	Length	Dorsal.	Anal.	Scales.	Teeth.	Depth.	Head	Position of dorsal.	Sex	Remarks.
	mm.									
1	115	12½	15½	12-63-6	2, 5-4, 1	3 3-4	4 1-4	(*)	♀	Keel nil.
2	104	11½	16½	10-61-?	2, 5-4, 1	4	4 1-3	(†)	♀	Keel evident.
3	103	11½	18½	10-55-5	2, 5-4, 2	4	4 1-4	(*)	♀	Do.
4	103	11½	17½	12-59-?	2, 4-5, 2	4 1-5	4 2-7	(*)	♂	Do.
5	95	12½	15½	56	1, 5-4, 1	4	4 1-3	(‡)	♀	Keel well marked.
6	92	11½	15½	....	....	4 1-2	4 1-4	(§)	?	Keel well developed.
7	91	12½	17½	57	2, 4-3, 2	3 3-4	4 1-5	(‡)	......	Keel nil.
8	85	11½	14½	....	....	4	4 1-5	(‡)	......	Keel well developed.
9	85	12½	16½	....	....	4 1-3	4 2-5	(§)	......	Keel scarcely evident.
10	82	11½	16½	....	....	4 1-4	4 1-4	(*)	......	Keel evident.
11	83	11½	16½	....	....	3 5-6	4	(‡)	......	
12	77	11	15½	....	....	4 1-4	4 1-4	(‡)	......	Keel evident.
13	73	12½	15½	....	....	4	....	(‡)	......	Keel well developed.
14	72	10½	15½	....	....	4 1-3	....	(‡)	......	Keel moderate.
15	68	11½	16½	....	....	4	....	(*)	......	Keel well developed.
16	67	12½	17½	....	....	3 4-5	....	(‡)	......	Do.
17	65	12½	15½	....	....	4	....	(§)	......	Keel strong.
18	62	11½	17½	....	....	4 1-5	....	....	......	Do.

* Equidistant from base of middle caudal rays and occiput (beginning of scaled region).
† Dorsal nearer base of middle caudal rays than occiput.
‡ Equidistant from base of middle caudal rays and upper angle of preopercle.
§ Equidistant from base of middle caudal rays and posterior margin of eye.

in the anal is enormous, but this I shall treat in detail. The scales are seen to vary from 10 to 14 above the lateral line; from 55 to 63 along the lateral line, and from 5 to 7 below the lateral line. There is nothing unusual in these variations, they are surpassed or equalled by other members of the same family. The variation in the teeth is great. With one exception, there are two teeth in the lesser row of the left side. The major row on the left side contains 4 or 5 teeth in the proportion of 1 to 6. In the right side, 3, 4 and 5 teeth were found in 4, 30, and 2 specimens respectively. In the lesser row of the right side, 13 specimens had 1 tooth, 20 had 2 teeth and one had 3. This last specimen, with dental formula 2,5–5,3, exceeds the dental formula of all the 175 Atlantic slope species of this family. Among these dental formulæ we find variations, the extremes of which have been taken as generic characters in other members of the Cyprinidæ.

The different combinations of teeth and the number of specimens having each number are as follows: One with 1,5–4,1; one with 1,5–4,2; two with 2,4–3,1; one with 2,4–3,2; one with 2,4–4,2; one with 2,4–5,2; one with 2,5–3,2; eleven with 2,5–4,1; sixteen with 2,5–4,2; one with 2,5–5,3. The usual or normal

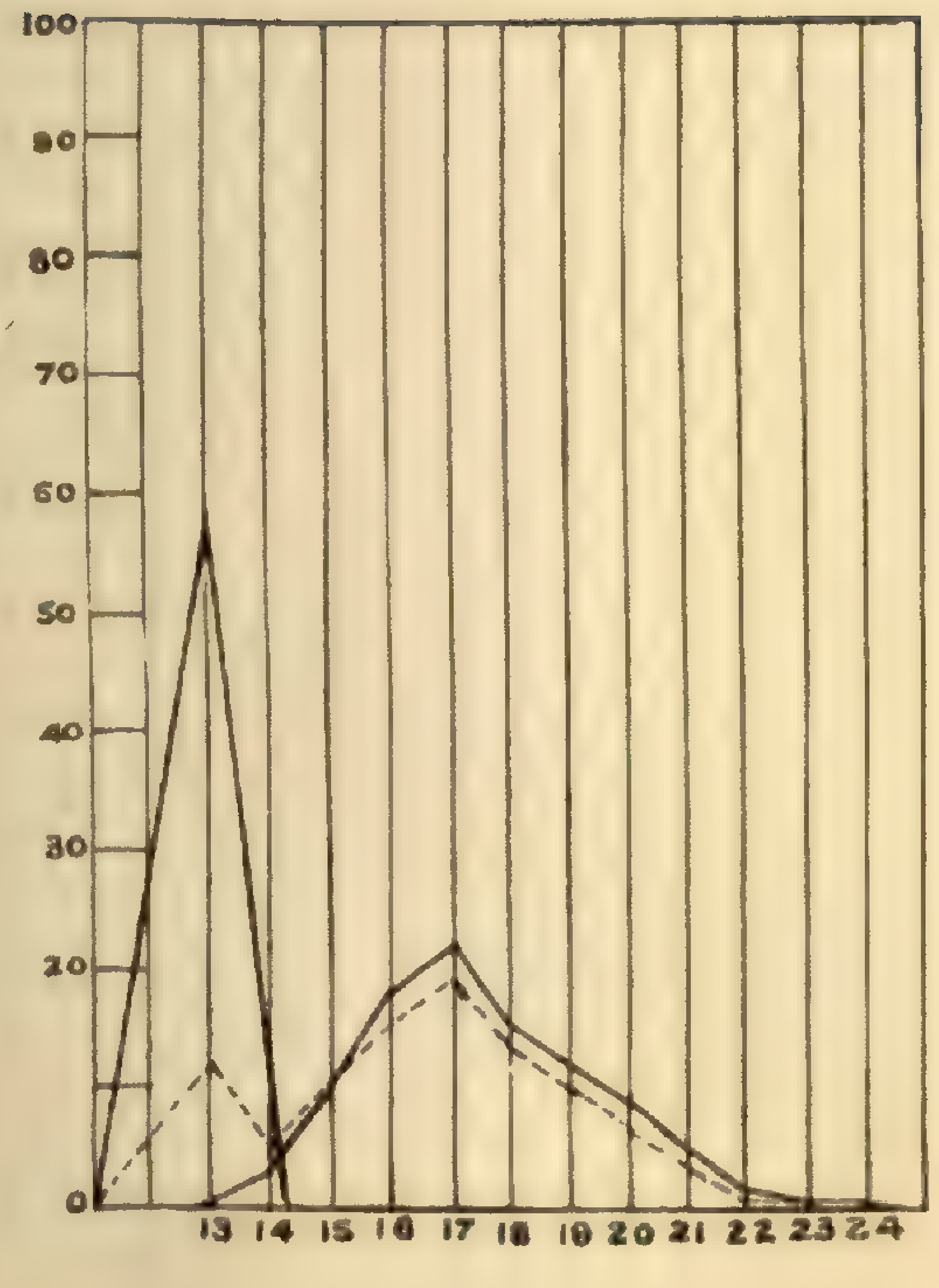
formula is 2,5–4,1 or 2. The variation through ten different combinations is exceptional.

The proportions, while varying considerably, do not show any wider fluctuation than usual. The position of the dorsal, on the other hand, varies considerably.

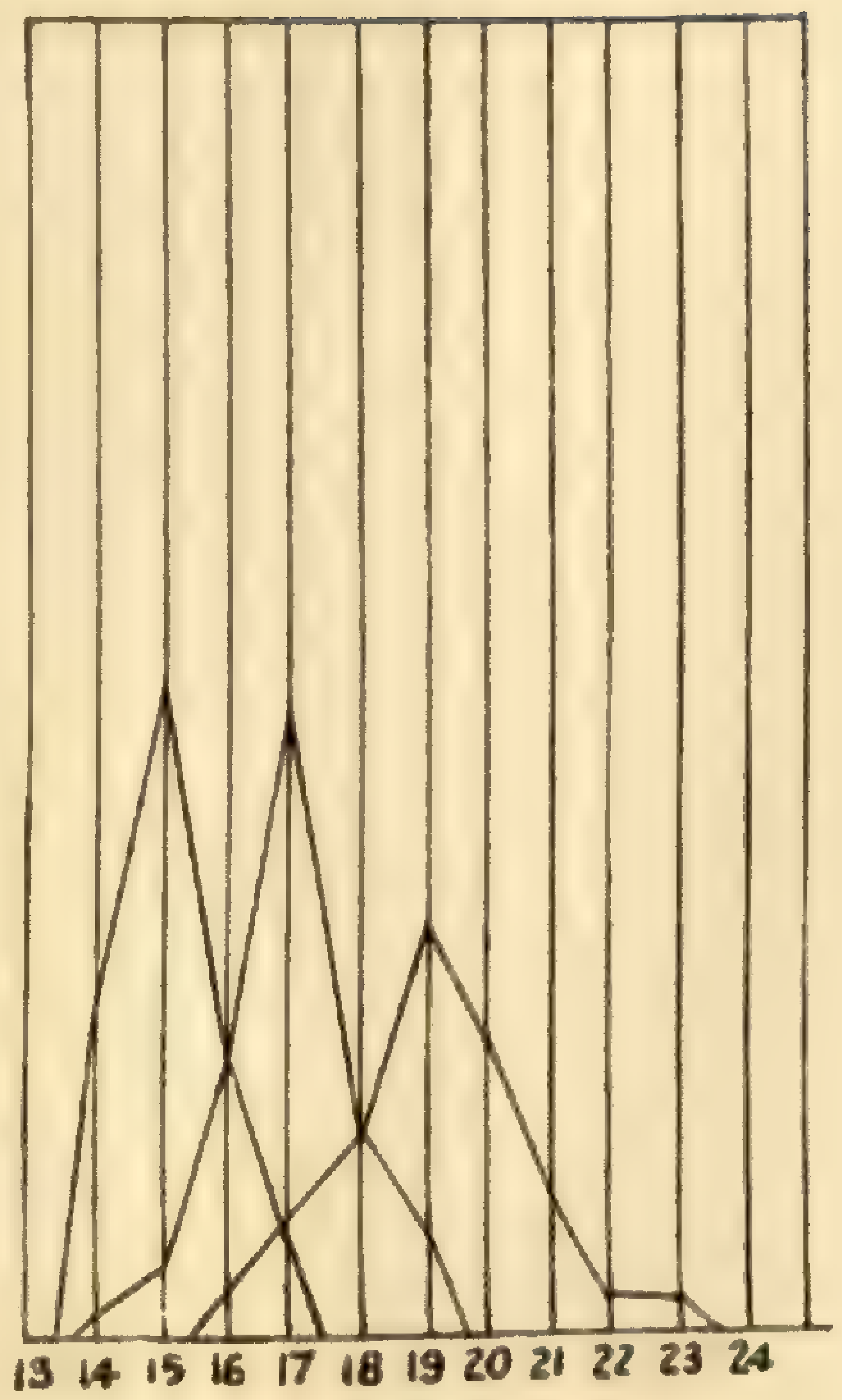
In the development of the keel behind the ventral fins we find again a great fluctuation in specimens from the same locality. In some, the keel is very sharp; in others, it is entirely absent, and between these forms, we have all shades of variation. If uniform, it would be of generic value.

Now, as to the variation of the anal rays. The lowest number recorded is 13 (after adding 2 to Gilbert and Evermann's lowest number), and the highest is 24. This gives a total variation of 12 rays. This would be a large variation for any fish but ,becomes phenomenal when it is considered that the variation in the number of anal rays of the 175 Atlantic slope species extends only from 6 to 14, a total variation of but 9 for 175 species as compared with the variation of 12 for a single species. The high number of rays reached is also phenomenal, for, leaving out of consideration the two rudimentary spines, the highest number of anal rays—22—is ten more than the number found in any other Pacific Cyprinoid, and 8 more than the number found in any Atlantic species. The average number of rays is 17. The variation to lower numbers extends through 4 rays to 13. The variation to higher numbers is much greater, extending through 7 rays to 24. Not only is the extent of variation greater towards higher numbers, but the number of specimens varying in that direction is much greater. Of 825 specimens, but 22.3 per cent. have the average number of rays. This is the largest per cent. for any given number of rays. Thirty-four per cent. of all the specimens have fewer than the average number of rays, while 42.9 per cent. have more than the average number. A more striking illustration of determinate variation could not be wished. Fig. 1 graphically represents the variation of the species as shown by the 825 specimens examined. The total height of the vertical lines represents the greatest possible number—100 per cent—that could have the given number of anal rays indicated at the

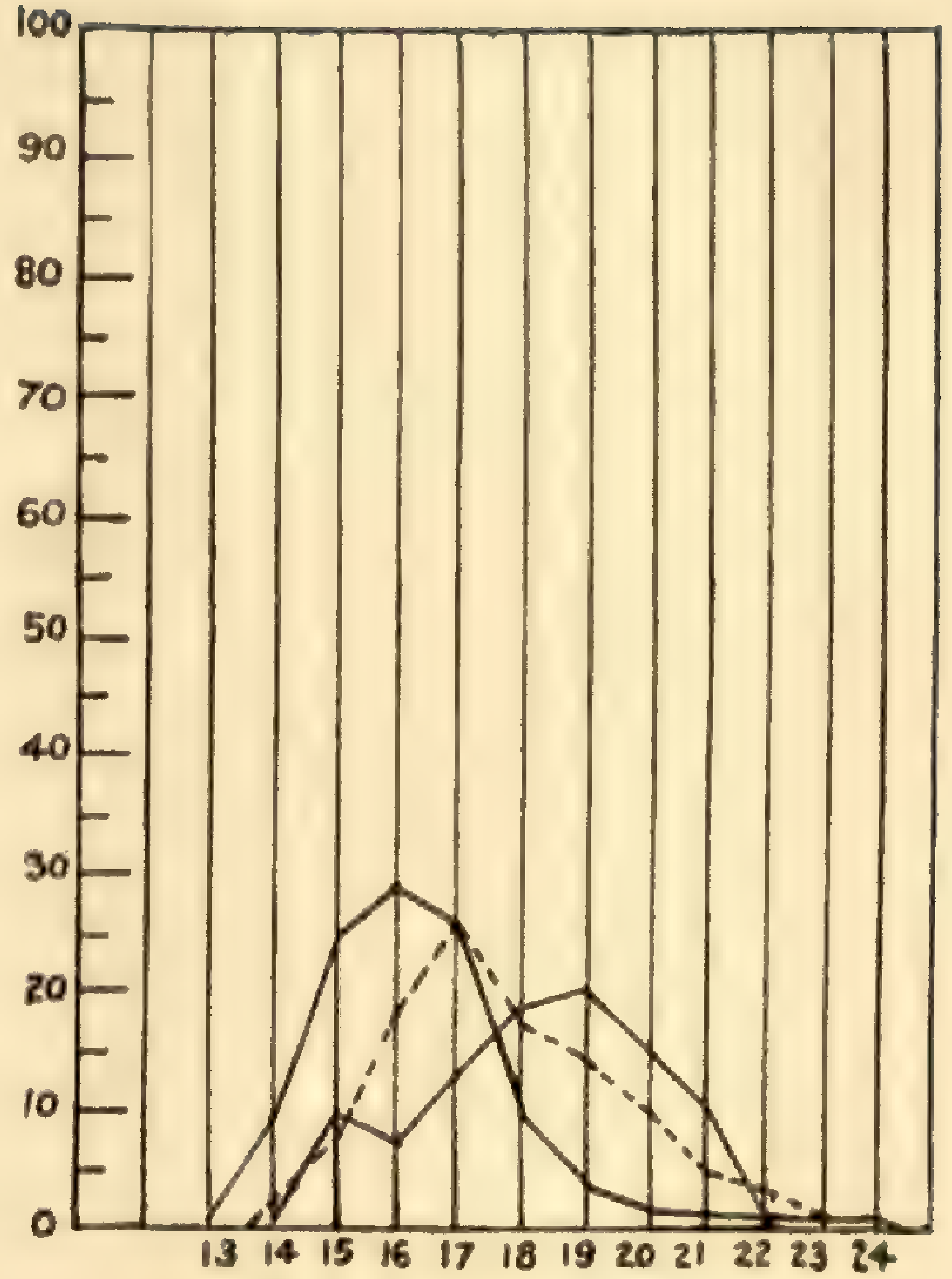
PLATE I.



1



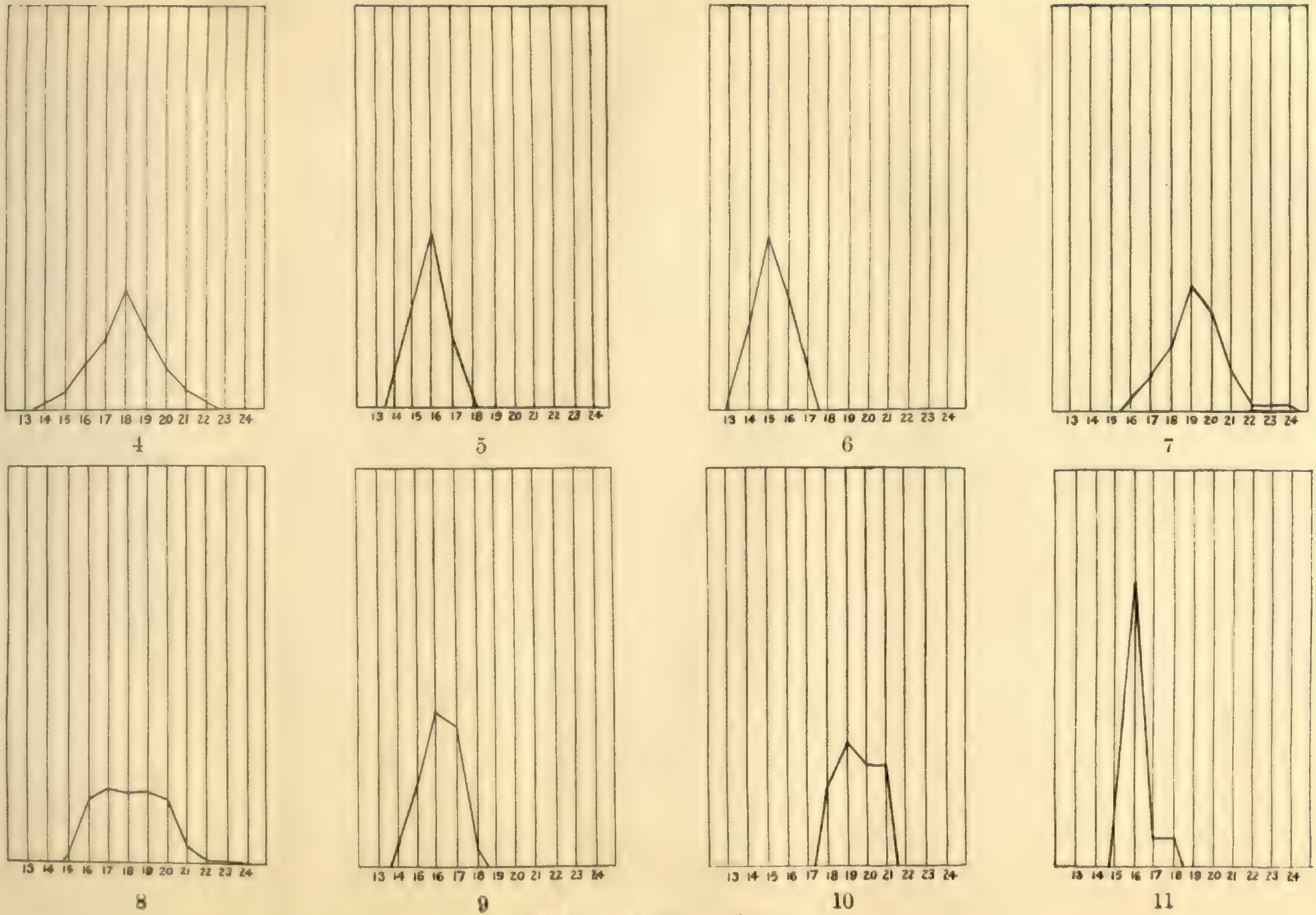
2



3

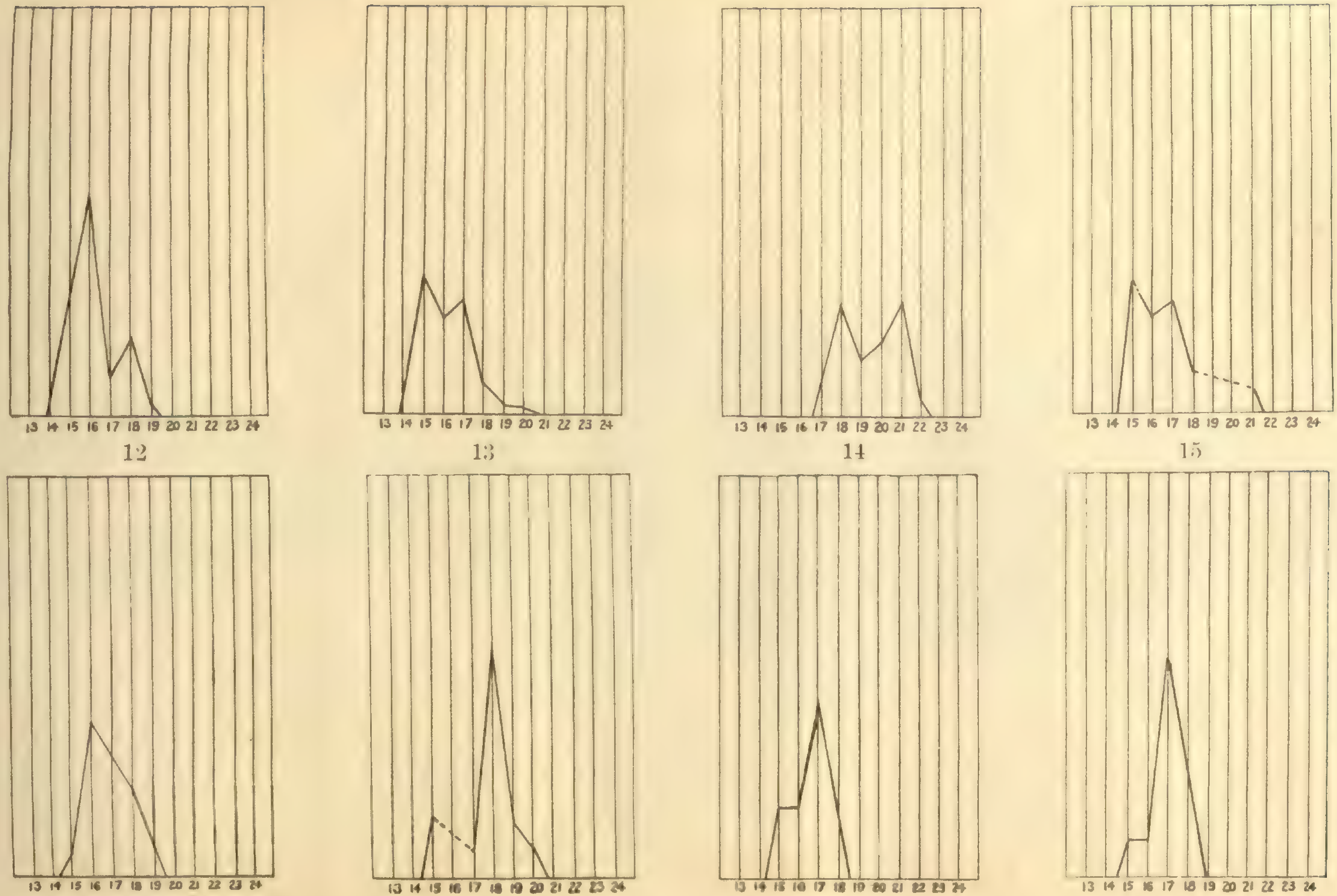
Leuciscus balteatus Rich.

PLATE II.



Leuciscus balteatus Rich.

PLATE III.



12 13 14 15

16 17 18 19

Leuciscus balteatus Rich.

PLATE IV.

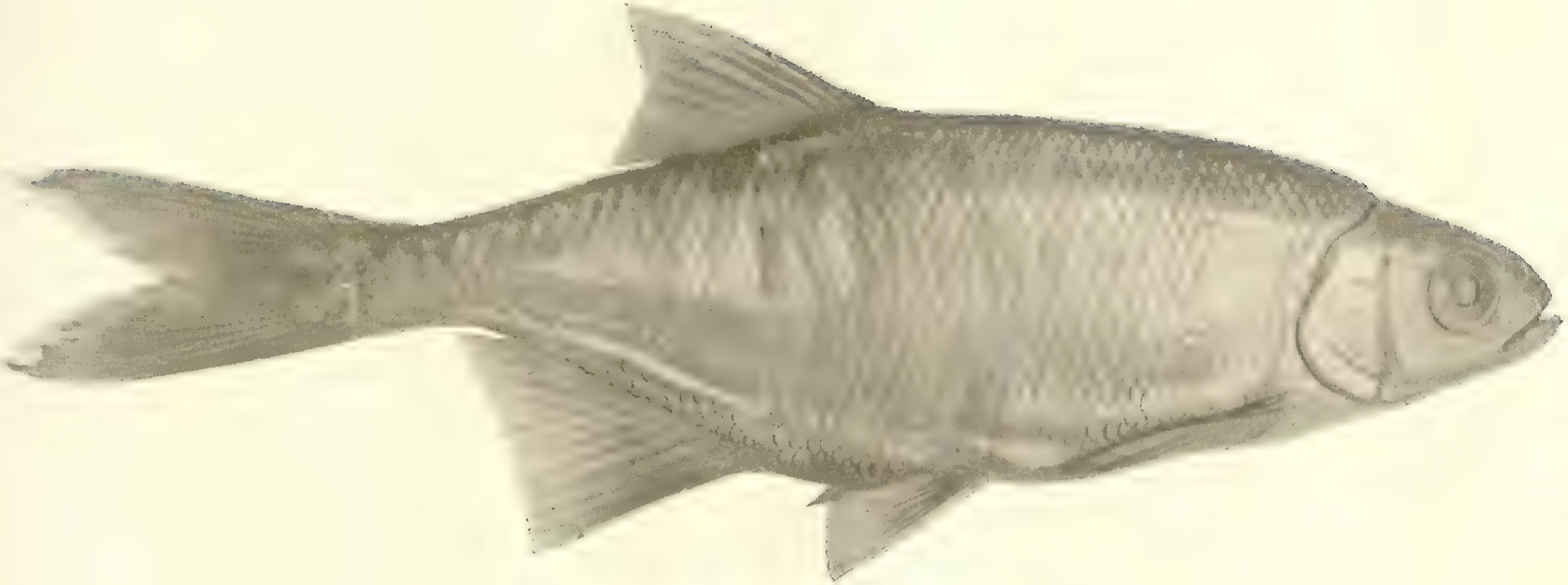


Fig. 20.—*Leuciscus balteatus* Rich.

PLATE V.

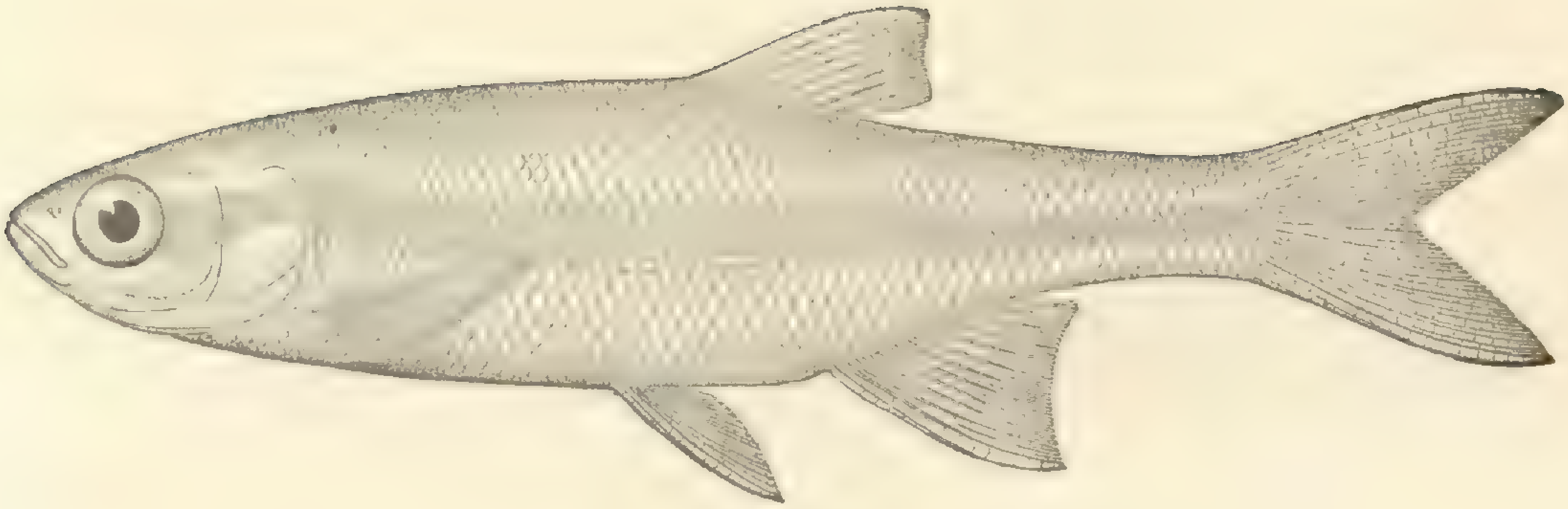


FIG. 21.

FIG. 22.

FIG. 21. *Leuciscus gillii.* FIG. 22. *Leuciscus hydrophlox.*

bottom of the lines. The curve shows the actual per cent. of specimens having each particular number of rays. Were the variation promiscuous, the curve would be symmetrical. The asymmetry shows the inherent tendency to higher numbers of rays in this fish. It may be well to bear in mind that no other species has a higher number of rays, that no other species joins this curve on the right, while at least one, probably two, related species living in the headwaters of the Snake River have fewer rays, *i. e.*, joins this curve on the left. The curve of *Leuciscus hydrophlox* not only joins this curve, but overlaps it, showing that in the number of anal rays *L. balteatus* and *L. hydrophlox* intergrade.

To facilitate the study of the local variations, I give below all the data concerning the 825 specimens of this fish. The first column gives the name of the stream and locality; the second column gives the elevation of the locality; the third the number of specimens collected at the given place; the fourth the extent of variation in the anal rays in the specimens from the locality, and the succeeding columns the number of specimens having the particular number of anal rays indicated at the head of the columns. The figures in the column representing the average number of rays for the specimens of the locality are in heavy face type.

After a detailed examination of the specimens collected by myself, I found that every locality has a variety peculiar to itself. The number of localities has been trebled by the explorations of Gilbert and Evermann, and the number of specimens raised from 250 to 825, and their detailed examination of these specimens bears out the above statement for every locality examined by them. Unfortunately, they allowed themselves to be side-tracked by minor issues, and did not mention this fact of local variation except in connection with other species.

I collected at three localities in the Frazer Basin. At Mission, B. C., I obtained 79 specimens in water which is affected by the high tides. At Sicamous, at an elevation of 1300 feet, I collected 58 specimens. At Griffin Lake, at an elevation of

DETAILS OF THE VARIATIONS IN THE ANAL RAYS.

Locality.	Elevation.	Num. of specimens.	Variation.	Number of Anal Rays. 13	14	15	16	17	18	19	20	21	22	23	24
Payette River, Payette	2150	154	9			3	25	29	27	28	25	12	3	2	
Boise River, Caldwell	2372	99	9		2	4	11	17	29	19	10	5	3		
Frazer River, Mission	1	79	9				2	7	13	25	18	8	2	2	2
Little Spokane River, Dart's Mill	1850	70	5	1	14	30	19	6							
Small Creek, at Sand Point, Idaho	2100	67	6			2	19	36	3	6	1				
Shuswap Lake, Sicamous	1300	58	6		1	3	13	28	8	5					
Lake Washington, Seattle	1	47	7		1	16	11	13	4	1	1				
Umatilla River, Pendleton	1070	26	5		1	5	10	9	1						
Grand Ronde, La Grande	2786	23	4		2	6	11	4							
Umatilla River, Umatilla	300	22	6					2	6	3	4	6	1		
Colville River, Meyers Falls	1200	21	7			7	5	6	2			1			
Columbia River, Golden, B. C.	2550	18	5		1	7	5	4	1						
Clear Water River, Lewiston	750	16	4						3	5	4	4			
Griffin Lake	1990	14	4		3	7	3	1							
Brown Gulch, Silver Bow	5344	14	4			2	10	1	1						
Skookumchuck River, Chehalis	204	13	6			2		1	7	2	1				
Spokane River, Spokane	1910	11	5		1	1	5	1	3						
Hangman Creek, Spokane	1910	11	4			2	2	5	2						
Flathead Lake	3100	11	4			1	1	6	3						
Snake River, Payette	2150	10	5						1	1	4	3	1		
Natchess River, North Yakima	1078	8	5		1		3	1	3						
Pend d'Oreille River, Newport	2000	8	3				5	1	2						
Walla Walla River, Wallula	326	6	4						2	2		2			
Post Creek, Flathead Lake	3100	6	3					4	1	1					
Potlatch Creek, Lewiston	1200	4	3						1	1	2				
Thompson River, Kamloops	204	3	2					2	1						
Newaukum River, Chehalis	375	3	3							1	1	1			
Columbia River, Pasco	1158	4	3					1	1		1		1		
Columbia River, Revelstoke	1475	1	1			1									

1900 feet, I secured 14 specimens. Four others were secured at Kamloops, but these are too few to aid us in our study.

The variation for these localities is represented by the three curves of figure two. The vertical lines stand for fin rays to total height of the figure for 100 per cent. The various heights of these curves represent the per cent of specimens having the given number of rays. The variation is seen to be much the greatest at Mission, a fact which is largely to be attributed to the greater number of specimens secured at this

place. The variation from the normal, which is 19 rays, to a higher number of rays, is as great as the entire variation for the next locality. At Sicamous, a much larger per cent. has the normal number of rays, but the normal number has been decreased to 17. The curve for Griffin Lake is interesting, because the normal number of rays has again been decreased by two. In other words, the higher the altitude the fewer the number of rays and the narrower the limit of variation.[5] Moreover, the curves are not symmetrical for any of the three localities, but, in the aggregate, the more gradual slope is on the side of an increase in the number of rays, a condition, which, considering the general variation of rays on the Pacific slope, seems to indicate that the number of rays of this species in the Frazer system is increasing, and that the increase is progressing from lower to higher altitudes.

A glance at the remaining curves will be sufficient to show that no two curves are alike, that the per cent. of specimens having a given number of rays differs with each locality. Naturally, the curves constructed from a large number of specimens represent the true conditions better than the curves constructed from but few. The extent of the variation varies largely with the number of specimens examined; that is, the probability of securing extremes becomes greater with an increase in the number of specimens collected. The greatest extent of variation for any locality, as far as known, is through 9 rays. This has been found only when over 70 specimens have been compared. It decreases to about 5 rays with 10 specimens. The total variation for the species has not been found at any one place.

The question of variation, with elevation, is an interesting one, and may be taken up in some detail.

In the following table, *all* the localities are grouped, according to their average number of rays.

[5] In their recent paper, Gilbert and Evermann have raised this specific statement, which occurs in my paper quoted above, into the dignity of a "theory" and "generalization" which it was never intended to be, and their arguments against it as a "theory" and "generalization" are, therefore, not appropriate.

Average number of rays.	Number of localittes.	Localities with their elevations in feet.
15	3	Little Spokane River, 1850; Griffin Lake, 1990; Revelstoke on the Columbia, 1475.
16	8	Lake Washington, 1; Umatilla River, Pendleton, 1070; Spokane River, 1910; Colville River, Meyers Falls, 1200; Columbia River, Golden, 2550; Grand Ronde River, La Grande, 2786; Silver Bow, Brown's Gulch, 5344; Pend d'Oreille River, Newport, 2000.
17	7	Newaucum River, Chehalis, 204; Natchess River, North Yakima, 1078; Sicamous, 1300; Hangman Creek, Spokane, 1910; Small Creek, 2100; Post Creek, 3100; Flathead Lake, 3100.
18	3	Payette River, 2150; Boise River, Caldwell, 2372; Skookumchuck River, Chehalis, 204.
19	5	Mission, 1; Umatilla, 300; Walla Walla River, 326; Potlacth Creek, 1200; Kamloops, 1158.
20	3	Clear Water, Lewiston, 750; Snake River, Payette, 2150; Columbia River, Pasco, 375.

The lowest average, 15, is found in but three localities, the lowest of which is at an elevation of 1475 feet. This last is of no value, since only one specimen was obtained and the chances are against an average specimen if only one is taken.

The second average is found all the way from tidewater to an elevation of 5344 feet. It is, however, notable that only one of the localities, Lake Washington, which does not belong to one of the two large water systems, is at a low elevation. The lowest of the other seven, all of which belong to the Columbia system, is at an elevation of 1070 feet.

The third average, which is also the general average for all the specimens, is found in seven localities, the lowest of which is at an elevation of 204, the highest at 3100. All but the first, which again does not belong to one of the larger river systems, are at an elevation above 1000 feet.

The fourth average ranges from 204 to 2372 feet.

The fifth average, 19 rays, is found in five localities, three of which are below 1000 feet and the highest is at 1200.

The sixth average, of 20 rays, varies from 375 to 2150 feet; two of them are at an elevation of less than 1000 feet.

This grouping does not show any uniform variation with the altitude. It may be emphasized that the lowest average is

not found below 1475 feet, that only one of the seven having an average of 16 rays is found below 1000 feet, and that but one of the eight having an average of 17 rays is found below 1000 feet. From the last but three specimens are known. It may be further emphasized that three of the five localities having an average of 19 rays, are found below 1000 feet, and that two of the three having an average of 20 rays are found below 1000 feet. Generally, the lower localities have the larger number of rays, to which there are several notable exceptions —Lake Washington and Snake River at Payette. These facts can be presented in curves for groups of localities. Taking the specimens from the different groups of localities we obtain the following:

Elevation.	Number of localities.	Number of specimens.	Extent of variation.	General average of anal rays
Feet.				
1 to 750	8	189	11	18.4
1078 to 2000	12	234	10	16.6
2001 to 3100	8	388	10	17.5
5000 to ——	1	10		16.

Whether we consider the number of localities having a high average of rays, or whether we consider the average of all the specimens from a similar horizon, we find that the largest number of rays is found in the lower horizon. Furthermore, the extent of variation for the 189 specimens, from 1 to 750 feet, is greater than the variation for 234 and 388 specimens of the higher horizons. The variation for these three horizons is given in the three curves of figure 3.

In the above we have considered the localities regardless of the system to which they belong. Lake Washington and the Newaukum and Skookumchuck Rivers belong to separate short water courses. Eliminating these and considering the localities of the Frazer and Columbia systems separately, we get the conditions described for the Frazer system above and for the Columbia system the following, arranging the localities in the order of elevation:

Locality.	Elevation.	Average number of anal rays.
Umatilla,	300	19
Wallula,	326	19
Pasco,	375	20
Lewiston,	750	20
Pendleton,	1070	16
Yakima,	1078	17
Colville,	1200	16
Potlatch,	1200	19
Revelstoke,	1475	15 (only one specimen).
Little Spokane,	1850	15
Spokane,	1910	16
Hangman Creek,	1910	17
Pend d'Oreille,	2000	16
Small Creek,	2100	17
Payette,	2150	18
Snake River,	2150	20
Caldwell,	2372	18
Golden,	2550	16
La Grande,	2550	16
Flathead,	3100	17
Brown's Gulch,	5344	16

Summarizing this: Below 1000 feet the averages are 19 and 20; above 1000 feet only one averages 20, only one reaches 19, two reach 18, four have 17, seven have 16, and two have 15. These figures "are not so unanimous in their indications" of a decrease of rays with an increase of altitude as those for the Frazer system. But the lower locality generally possesses a high number of rays. Here, where we have data from many widely separated branches, a close variation of rays, with altitude, is not found. Local issues have modified national tendencies among these fishes in the Columbia system.

Among the locality curves (figures 4 and following) the ideal curve is most nearly approached at Caldwell. The variation from the average is here equally great in both directions; and the curve of the ascending variation is almost identical with the curve of the descending variation. Nearly as ideal condi-

tions are found at Little Spokane, where the extent of variation is much smaller. *A priori* such symmetry or approach to symmetry is to be expected for each locality, but the deviations from it are many and great. The many shoulders and peaks in localities from which but few specimens have been collected, indicate probably nothing so much as the lack of a sufficient number of specimens. When but ten specimens are examined, each specimen, more or less, makes such a vast difference in the character of the curve that the localities with less than 20 specimens may be dismissed without further notice.

Aside from curves, such as that of Little Spokane, where a certain number of rays is the predominant one, we have curves such as that of the Payette River, where the number of specimens having 16, 17, 18, 19 and 20 rays, is nearly equal. Still another type of curve is represented by the curves for Lake Washington, Colville and Umatilla, in which two numbers predominate, with the intervening numbers in minority. The conditions are most marked at Umatilla, where we have two incipient varieties with 18 and 21 as the predominating number of rays.

I have given, at the outset, the probable causes which have brought about the great differences between the Pacific slope fishes.

We must look to other causes for the great variation between species of undoubted Atlantic origin, and especially the variation in the same species, which reaches its culmination in *Leuciscus balteatus* and *Agosia nubila.* The climatic, altitudinal and geological differences in the different streams, and even in the length of the same stream, are very great on the Pacific slope. To these different environments we must attribute the conditions set forth in the present paper for *Leuciscus balteatus.* These differences in different localities in the same stream can only become established in nonmigratory species. No such differences are to be expected for a migratory species. To a migratory species, such as the species of Salmo, different rivers bear the same relation as different localities on the same river to a non-migratory. Isolation for the specimens of

any locality, when free intermigration is possible, seems strange. An analgous condition is to be found on the Galapagoes Islands. Dr. Baur tells me that islands within plain sight of each other harbor distinct varieties of the same species of birds which could readily intermigrate, but do not.

This raises the question of the sort of influence exerted by the environment. Is it merely selective, or is it directive? Is the variation promiscuous and inherent in the species, or is it determinate and forced in certain directions by the environment? The latter seems to me the better way of reading such conditions as are represented by the many curves which show a greater variation towards an increased number of rays than towards a decrease of rays. Here the variation is not promiscuous, but definitely determinate. See, in this connection, the curve for all the specimens.

The origin of new varieties is admirably illustrated by the curves for Lake Washington and Umatilla. In these, two distinct peaks are found. While no varietal value is claimed for these peaks, isolation of members of such peaks, either physiologically or locally, would tend to establish such incipient varieties.

Explanation of Figures.

The vertical lines, in all cases, stand for a definite number of anal rays. The total height of the figures represent 100 per cent., and the height of the curves, at any point, the per cent. of specimens having the particular number of rays in the anal.

Fig. 1. Curve of variation for 217 specimens of *Leuciscus hydrophlox* from the upper Snake, and for 825 specimens of *Leuciscus balteatus* from many localities, varying from 1 to over 5000 feet in elevation.

a, the two series of specimens are combined in the broken line curve.

Fig. 2. Three curves showing the variation of the three localities represented from the Frazer system:

Griffin Lake, 1900 feet, 17 specimens.
Sicamous, 1300 feet, 58 specimens.
Mission, 1 foot, 79 specimens.

Fig. 3. Three curves showing the variation:

a, of 234 specimens from 1000 to 2000 feet elevation.

b (broken line), 388 specimens from 2000 to 3000 feet elevation.

c, 189 specimens from 1 to 1000 feet elevation.

Fig. 4. Variation of 99 specimens from Caldwell, 2372 feet.

Fig. 5. Variation of 23 specimens from La Grande, 2786 feet.

Fig. 6. Variation of 70 specimens from Little Spokane, 1850 feet.

Fig. 7. Variation of 79 specimens from Mission, 1 foot.

Fig. 8. Variation of 154 specimens from Payette River, 2150 feet.

Fig. 9. Variation of 26 specimens from Pendleton, 1070 feet.

Fig. 10. Variation of 16 specimens from Clearwater, 750 feet.

Fig. 11. Variation of 14 specimens from Brown's Gulch, 5344 feet.

Fig. 12. Variation of 67 specimens from Small Creek, 2100 feet.

Fig. 13. Variation of 47 specimens from Lake Washington, 1 foot.

Fig. 14. Variation of 22 specimens from Umatilla, 300 feet.

Fig. 15. Variation of 21 specimens from Colville, 1200 feet.

Fig. 16. Variation of 18 specimens from Golden, 2550 feet.

Fig. 17. Variation of 13 specimens from Skookumchuck, 204 feet.

Fig. 18. Variation of 11 specimens from Hangmans Creek, 1900 feet.

Fig. 19. Variation of 12 specimens from Flathead Lake, 3100 feet.

Fig. 20. *Leuciscus balteatus* from Mission, the specimen now in the British Museum.

Fig. 21. *Leuciscus gilli* from Brown's Gulch.

Fig. 22. *Leuciscus hydrophlox.*

The last two cuts are reproduced by permission of Hon. Marshall McDonald, U. S. Commissioner of Fish and Fisheries.

ON THE EVOLUTION OF THE ART OF WORKING IN STONE.

By J. D. McGuire.

A REPLY TO MR. CHARLES H. READ.

There appeared in the American Naturalist for December, 1894, a communication by Mr. Read, one of the keepers of the British Museum, in reply to my paper on working in stone. Mr. Read having "given attention to the problem itself" thinks it "necessary to point out the danger that lies in the use of improper or irrelevant evidence;" he thinks the paper "so persistent in its pursuit of will-o'the-wisps that a better text could scarcely be found."

As Mr. Read represents the typical European believer in a palæolithic period, as distinguished from the neolithic, and as the writer calls in question the correctness of this distinction, it may be well that the public shall have an opportunity to decide who is chasing phantoms.

Mr. Read himself calls the question a "puzzle," the writer considers it a plain subject having little difficulty of solution. The original paper discussed the matter chiefly from a technical standpoint and showed, that among European writers on the subject there was absolute contradiction, and the greatest uncertainty.

There is nothing in the writer's paper calculated to mislead any one, for where experiment showed a condition, it was stated; and where an author was quoted, his name was given.

A great many American archæologists deny that the question is a "puzzle" as alleged by Mr. Read, although they confine their expressions to American conditions. The writer has not hesitated after a most thorough investigation to say that European authors *do not* agree even among themselves on the subject.

In the original paper it was stated "that a person capable of chipping out a palæolith after at most, a year or two spent

in such manipulation, would have acquired the skill requisite to batter an implement into shape, and subsequently, if necessary, to grind a blade to it." The expression was thought to be considerate of the feelings of those who advance the untenable theory that man lived through centuries upon centuries of time, chipping stones, and never battering them into shape, nor even learning the process by which it was done; when as a fact, the art of chipping, if attempted upon a granular, igneous or metamorphic stone, of which implements are commonly made, would by that very act become a *battering process;* for such stones do not chip when struck an ordinary blow.

This is not a "theory" nor is it "based upon the writers own experience as an amateur maker of stone implements." Mr. Read has not been particular in the selection of the terms used, so it may be appropriate to say here that the writer has made few stone implements, and those few are exhibited in cases in the U. S. National Museum along with the tools with which they were made, and all are numbered and labeled. In doing the work, much material was necessarily destroyed, but the results appear fully to justify the expenditure, and are considered as valuable by those who have given them careful scrutiny.

Mr. Read is unfortunate in asking if the writer has ever seen a specimen of Kafir or Polynesian carpentry, and says "both cut everything from the solid," and because the British Museum possesses specimens of chairs, with legs and backs similar to European furniture, but cut from solid blocks, asks "Are we to think that they began with joining, *without doubt the easier method,* and finally came to the more difficult, the cutting from the solid?" "Surely not." Mr. Read says "the natural explanation is the best, simply that the easier method did not occur to them."

Let us answer this fully. The writer has seen Polynesian and African carpentry, in both of which the U. S. National Museum is rich, but these people do not differ in that respect from most, if not all other savage races of the world in cutting almost everything from the solid. Mr. Read's assertion that

joiner work is simpler than working from the solid, will not be accepted on this side of the Atlantic, and any farmer's boy would laugh at such a suggestion even in England if he believed it to be seriously made. It is difficult to imagine how Mr. Read can suppose a chair with back and legs could be made out of wood by joining more easily than from the solid, if he thinks for one moment of the boring and mortising necessary in joiner work. Not only the operation but also the tools used in joiner work are more complicated than in carving from the solid.

It is a pleasure to hear Mr. Read express his preference to speak of palæolithic man in Europe, for in America the friends of palæolithic man have with few exceptions deserted the proposition as an unsupportable theory.

Mr. Read asserts that the writer's "views" are at a variance with that of others, and says: "Palæolithic implements are made chiefly of flint and quartz;" this is one of the great troubles, for if an igneous, granular or metamorphic stone is found ground into an implement, European archæologists insist that the article is neolithic, apparently not appreciating that the stones enumerated cannot be chipped. Flint implements require chipping; cliorite, on the other hand, requires battering.

The writer advisedly speaks of "stone" for the subject of the paper is stone and not *flint* as Mr. Read would have it. The writer's assertion is plain and is repeated, the process of *battering* a material is simpler than the process of *chipping* a material. The writer regrets that "it seems inconceivable that such a statement could be calmly made, seeing how entirely contrary it is not only to the experience of all who have tried the experiment, with the single exception of Mr. McGuire, but also in direct opposition to all the evidence on the subject." Mr. Read is here again decidedly confused in his mechanical methods and information, for until the writer demonstrated the process of battering, and showed it to be common to the whole world, it was declared to be a problem in archæology that was unsolved and not demonstrable, there-

fore, except the writer's paper on the subject, there does not appear to be any evidence one way or the other.

Again, Mr. Read asks "Can Mr. McGuire point out a single instance of a polished implement being found on an admitted palæolithic site?" If a palaeolithic site is one on which no battered or polished stones are found, No! In compliance, however, the writer will cite the upper cave of Wierszchow in which a polished celt of diorite was found; in this cave were also *Ursus spelaeus, Hyaena spelaea*, etc., according to Dr. Ferd. Römer, nor is this the only cave by any means. For fear, however, lest the advocates of palæolithic man may say this is not an admitted site, we will refer to the bone caves of France, admittedly of the palæolithic period. In them carved antlers are *commonly* found, and ivory tusks worked into plates; to shape which required sawing and grinding, work *similar* to that on the typical neolithic implements. The caves of England have produced bone needles *ground* into shape. Many caves of the continent have produced whistles and various other objects of stone, shell, bone and ivory having holes *bored* through them. These articles are all found in Quaternary strata, and are referred to by most all archæologists as palæoithic. To work such material (it being harder than much of that of the neolithic period, requiring similar treatment to that requisite to produce the neolith) certainly required a similar mechanical ability in the people of the earlier when compared with that possessed by those of the later period, yet if this be admitted, the palæolithic period thereby collapses.

It does not savor of fairness for Mr. Read to say the writer "is fighting air, to bring a long array of his own experiments to prove that palæolithic man ought to have found out what he considers the easiest way of making his tools." If the articles quoted above were found where their Europeon authors say they were, of which too there appears no doubt, is there not something more substantial than "air" in the argument?

The statement that "the fact that palæolithic man *overlooked* the polishing of his implements is a mere accident, a subsidiary and incidental peculiarity, and possesses no right to the importance it has obtained" is choice verbiage, but is not argu-

ment calculated to support the theory of the correctness of palæolithic man or of such a period.

American archæologists are unwilling to rely upon the soundness of arguments that appear to be intended to charge, that those who do not blindly follow European dicta, are incapable of expressing opinions of value. Sir John Lubbock's definition of "palæolithic" and "neolithic" broadly given, is a distinction of the intelligence of the peoples of the two periods as evidenced by the articles of their handiwork, and yet holds good.

The reputation gained by that patient French archæologist, Boucher-de-Perthes in his investigations in the valley of the Somme, was well deserved, but the same cannot be said of those others who are endeavoring to discover new eras of man's existence, extending over eons of time, and through gradations of chipping their tools in periods christened "pre-palæolithic," "eolithic," "mesolithic" and the various cave periods, the names alone of which, are sufficient to convince thoughtful persons that they are on doubtful ground.

The history of these newly christened eras has been that, by the time their sponsors become familiar with the names, they abandon them, until now the structure has crumbled so absolutely that a geological stratum alone decides the question, and if specimens are found in it, no matter how finished they be, whether chipped or polished, they will be accepted. The libraries of America are well stocked in archæological literature. American students have done some good work; they are willing to welcome intelligent inquirers to the fold, as there is abundance of room. Yet Americans are fast recognizing a rule, that where assertions are made archæologically, they demand a reference to the locality or the author or the specimen, and they are unwilling to accept a guess. Palæolithic man has been a fad for years, a myth and phantom, who whether he will or no, must give way to man a reasoning being, an intelligent and implement using creature.

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RECENT LITERATURE.

Packard, on the Inheritance of Acquired Characters.[1]—The time has not yet come for deciding the question which is the nearer right, the neo-Lamarckian or the neo-Darwinian school. Both have their arguments to advance and both find facts not easily to be explained by theories of the other. Yet, to us, it seems that a portion of the difficulties seem to lie in language rather than in views, and that not a little of the confusion is one of words. What Professor Packard has to say must necessarily attract attention, and, while not attempting to criticise his article as a whole, the reviewer would point out that apparently our author has been troubled by Weismann's terminology, and does not clearly appreciate the limitations placed by the Freiburg zoologist upon the expressions acquired characters, congenital variation and the like. Thus (p. 345) Packard quotes the experiments of Paul Bert upon Daphniæ, in which the adults were killed with salt water while the eggs in the brood-sac survived, as "a case in favor of the neo-Lamarckian principle," by which we suppose him to mean that the young inherited an acquired character before the parents had acquired it!

Again (p. 339), we read, "If congenital characters are the only ones which can be inherited, they must have, in the beginning, originated from those acquired during the lifetime of the individual, or, if not in the first, in the second or third, or a later generation." Here the answer is easy, the word "acquired" is used with a significance totally different from its limitation by Weismann, and it is upon this misuse of terms that our author is led into this later inquiry, "If there were no such thing as the transmission of characters, either anatomical, physiological or mental, originating during the lifetime of an organism, how should we have any evolution resulting in the different groups of organisms?" It is, it seems to us, this confusion of words which is at the bottom of Professor Packard's trouble. We think that a careful reading of Weismann's "Ueber die Zahl der Richtungskörper und über ihre Bedeutung für die Vererbung (1887)," will show one easy way out of this difficulty; whether it be the right one or not, we are not ready to say.

[1] On the inheritance of acquired characters in animals with a complete metamorphosis. Proc. Am. Acad. Arts and Sciences, XXIX, pp. 331–370, 1894.

In another place, Dr. Packard quotes the fact that Bacteria can be altered by changed environment, but has not Weismann pointed out that the unicellular forms stand upon an entirely different basis from the many-celled species, and that acquired characters must be transmitted among them? Aside from some features like this, Professor Packard's paper must be regarded as a strong presentation of the neo-Lamarckian position.

Proceedings of the Indiana Academy of Science for 1893.—Among the foremost of the State scientific organizations is the Indiana Academy of Science, the third volume of whose Proceedings is before us. Of its 274 pages, 70 are occupied by the papers read at the annual meeting in the holidays a year ago, among which especially noticeable are the presidential address of Dr. J. C. Arthur upon "The Special Senses of Plants;" E. W. Olive's paper on the "Histology of the Pontederiaceae," and Professor Eigenmann's "Effect of Environment on the mass of Local Species." More important than these is the account of the work outlined and that already done towards a Natural History[2] Survey of the State. Necessarily, the matter presented is preliminary; a getting together of bibliographies and lists of species, but so enthusiastically has the beginning been made, that we doubt not that in a few years the whole Natural History of the State will be adequately understood. For many years Indiana has maintained a so-called geological and natural history survey, but so thoroughly has this been dominated by politics that but little good has been accomplished by it. One geologist would scarcely get the harness on when a new election would put a new person in the office, a condition which has been fatal to any definite policy. But worst of all has been the fact that nominations, for many years past, have been controlled by party pull, fitness for the position not being at all essential. The result has been that since the days of Cox and Collett, the office has been occupied by persons who, no matter how estimable they may be, are unknown to the world of science, and their reports have been scarcely more than a waste of so much good paper. This year it is true, the standard has again been raised, but this is but one of the accidents of a thoroughly pernicious method. The next election is apt to replace the present incumbent by one as ill adapted for the place as some of his predecessors.

[2] Although it includes Geology, the Survey is throughout spoken of as the "Biological Survey."

Now the Academy comes forward with its plans for a complete survey, and in this laudable undertaking it should have every encouragement. With a resident membership of over 100, there is a chance for more thorough and more careful work than can ever be attained in any other way, while, naturally, as long as the Academy has such leaders as Arthur, Butler, the Coulter brothers, Eigenmann, Hay, Mottier, Underwood, etc., we may be sure that fitness, rather than any other qualification, will determine the assignment of special work. With these conditions, would it not be well for the next Legislature to do away with its comparatively useless State Geological Survey and turn over to the Academy, of course with proper restrictions, the funds which are now annually given to the former organization. At any rate, the people of the State should encourage the Academy in its endeavors, and the State itself should be willing to defray at least the expense of publishing results as valuable as these will undoubtedly be.

General Notes.

MINERALOGY.[1]

Identity of Rhabdite and Schreibersite.—The fine needles of phosphide of iron and nickel which in many meteorites accompany or take the place of the larger crystals or lenses of schreibersite, go under the name of rhabdite. Whether rhabdite is identical with schreibersite has long been in question. After carefully separating the material from the matrix, Cohen[2] has made analyses of rhabdite from five localities with the following results:

	Fe	Ni	Co	P
1. Seeläsgen, Prussia	49.76	36.17	0.46	13.61
2. Lime Creek, Ala.	51.10	32.99	0.42	15.49
3. Bolson de Mapimi, Mexico.	52.54	31.71	0.72	15.03
4. Sancha Estate, Cape Colony.	55.30	28.78	0.60	15.32
5. Hex River Mts., Cape Colony.				
a) needles	56.71	27.36	0.47	15.46
b) plates	62.45	21.71	0.35	15.49

These analyses show the formula of rhabdite to be $(Fe\ Ni\ Co)_3\ P$ or identical with that of schreibersite. Kamazite is found to be like taenite, an alloy with narrow limits for the variation of cobalt and nickel. Wülfing[3] has published a handy list of the meteorites in the world's collections.

English's New Catalogue of Minerals.[4]—The average trade catalogue of minerals is unsatisfactory because it fails to supply desired information concerning crystallography, occurrence, locality, etc. The recent catalogues of English and Company have shown a great advance over this type of catalogue, in, that beside the needed information concerning the locality, there has been added, in the case of recently described occurrences, a reference to the original description. Another valuable feature is the insertion of miniature cuts indicating the devel-

[1] Edited by Dr. Wm. H. Hobbs, University of Wisconsin, Madison, Wis.

[2] Ann. k. k. naturhist. Hofmuseums, ix; Heft 1, pp. 97–118, 1894.

[3] Jahresheft d. Verein f. vaterl. Naturkunde i. Wurtemberg, Jahrg. 1894, pp. 1–21.

[4] Catalogue of Minerals, Geo. L. English & Co., 16th ed., pp. 124. New York, June, 1894.

opment of crystallized specimens. This mode of illustration can hardly be carried too far to suit the taste of the professional mineralogist, but as it involves expense and time in the preparation of the catalogue, we would suggest that the particular combination exhibited by a crystal might nearly as well be indicated by the use of form symbols. The sixteenth edition of English's catalogue contains a classified list of mineral species arranged like that in Dana's "System" (6th Ed.), in which is given after each species the symmetry, hardness, specific gravity, and chemical composition. A supplement to the list includes the species mentioned in Dana's supplement as well as minerals of more recent description. The book is quite free from errors and contains an alphabetical index. Only about one-third of the book is devoted to advertising.

Leadhillite from near Granby, Missouri.—The rare mineral leadhillite occurs near Granby, Mo., in part in good crystals associated with massive cerussite. As studied by Pirsson and Wells[5] these crystals are either prisms or plates having dimensions of one or more centimeters. The symmetry is monoclinic and pseudo-hexagonal, and the combinations are simple, usually (001), (110) and (100), more rarely also (201), ($\bar{4}$14) and ($\bar{4}$18). Twinning parallel to the unit prism is common and the basal cleavage is perfect. The physical and optical properties agree in the main with those of the already known leadhillite. The etched figures on the base (dilute nitric acid) closely resemble those of the micas. An analysis gave the following results:

SO_3	CO_2	PbO	H_2O	Total
7.33	8.14	82.44	1.68	99.59

The formula for the mineral is therefore $Pb\ SO_4 . 2Pb\ CO_3 . Pb(OH)_2$, which does not agree with any of the other published analyses of the mineral but is the formula which has been suggested by Groth.

Two New Instruments for Mineral Study.—Tutton[6] has published a brief preliminary notice of two important instruments which he has devised, full descriptions of which will be printed in the Philosophical Transactions. One of these is a delicate instrument for grinding very accurately in any desired direction, prisms and sections of minerals for optical study. In half an hour the two surfaces of the section may be prepared. The method is specially adapted to cut-

[5] Am. Jour. Sci., xlviii, pp. 219–226, Sept., 1894.

[6] Proc. Roy. Soc., lv, (1894), pp. 108–113.

ting the fragile crystals of artificial compounds. It is possible to grind and polish a truly plane surface in any desired direction accurate to within ten minutes of arc. The second device is likewise a somewhat elaborate one for securing monochromatic light of any desired wave-length. This apparatus, which is specially adapted to axial angle instruments, goniometers, spectrometers, stauroscopes and microscopes, secures for the whole field even and bright illumination by monochromatic light of any desired wave-length.

Miscellaneous Notes.—Moses[7] describes a simplified method of obtaining the projection of the crystallographic axes in clinographic projections of crystals.—Luquer[8] gives in concise form, characters for the optical recognition of the common minerals found in building stones. The form is a convenient one for use, but some quite misleading statements are included, such as the differentiation of quartz from nephelene and apatite "by absence of hexagonal crystals." Apatite and orthoclase are both said to have low relief.—George Otis Smith[9] describes two very large scapolites from Eel Lake, six miles from Kingston, Ontario, on which the third order pyramid $\left(\frac{3P3}{2}\right)$ (131) is developed at both ends of the crystals. The larger crystal exhibits all the known forms of scapolite except the base. Smith in the same paper examines the monster gypsum crystals of the South Wash, Utah, and a prism thought to be one described by Moses[10] as a new form (450), is found to be the known form (340).—Penfield and Kreider[11] show that hydrofranklinite and chalcophanite are identical. Hydrofranklinite is not isometric as supposed by Roepper, but rhombohedral, the combination shown in the crystals being rhombohedron and base.

Penfield[12] has found a crystal of octahedrite among brookites from Magnet Cove, Ark. Penfieldite[13] is described in detail. The mineral has holohedral hexagonal symmetry, distinct basal cleavage, and strong, positive double refraction. A study is made of the cleavage of albite and oligoclase[14] in which it is shown that the oligoclase from Bakersville, N. C., exhibits two varieties; the one twinned polsynthetically accord-

[7] School of Mines Quarterly, xv, pp. 214–218.

[8] Ibidem, pp. 285–336.

[9] Johns Hopkins Univ. Circulars, No. 112, May, 1894.

[10] School of Mines Quaterly, xiv, p. 325; Science, xxi, p. 230.

[11] Am. Jour. Sci., xlviii, pp. 141–143, Aug,, 1894.

[12] Am. Jour. Sci., xlviii, pp. 113-118, August, 1894.

[13] Penfield, ibidem.

[14] Penfield, ibidem.

ing to the albite law and cleaving well parallel to (010), the other being without twinning or brachy-pinacoidal cleavage, but separating well parallel to (12$\bar{1}$). This suggests that the common cleaving of plagioclase parallel to (010) may be only parting. In an albite from Amelia County, Va., a few parting planes parallel to *m* (110) and *o* (1$\bar{1}$1) were observed. Lehmann's experiment of producing the prismatic parting in normal albite by throwing heated albite fragments into water, was repeated, but no tendency to develop the pyramidal parting under these circumstances was apparent. By holding in a vise and subjecting to a pressure in the direction of the *b* axis, both the partings (110) and ($\overline{11}$1) were produced in the Amelia albite. Hurlburt[15] describes alunite filling pockets and seams in the ore body at the National Belle mine at Red Mountain, Ouray County, Col. Analysis furnished the following results :

SO_2	Al_2O_3	K_2O	Na_2O	H_2O	Insol.	Total
38.93	39.03	4.26	4.41	13.35	.50	100.48

This furnishes the formula (K Na) (Al [OH]$_2$)$_3$ $(SO_4)_2$, sodium and potassium being present in the proportions 4 : 7 as in the alunite described by Cross from the Rosita Hills.[16]—Cerussite is described by Pratt[17] from the Judge Mine, Black Hawk, Meager County, Mont., in crystals having the forms *b* (010), *c* (001), *m* (110), *x* (012), *v* (031), *i* (021) and *p* (111). In the same paper are described the zircons from the nepheline syenite of Dungannan and Farady, Ont. These are sometimes so distorted as to resemble the combination of a flat rhombohedron with a second order prism. Other crystals are almost ideally developed and exhibit the forms *p* (111), *a* (100), *m* (110) and *v* (221).—Ingersoll[18] describes hemimorphic wulfenite crystals from the turquoise mines in the Jarilla Mts., N. M. The hemimorphic character is indicated by the general habit and by the occurrence of the second order pyramid (20$\bar{1}$) only in the lower portion of the crystal. The pyramidal hemihedrism is indicated by the occurrence of the pyramid of the third order, π (313).

[15] Am. Jour. Sci., xlviii, pp. 130–131.

[16] Am. Jour. Sci., xlviii, p. 466, 1891.

[17] Ibidem, xlviii, pp. 212–215. Sept., 1894.

[18] Ibidem, pp. 193–195.

PETROGRAPHY.[1]

The Serpentines of San Francisco.—The serpentine of the Protero, a district within the limits of the city of San Francisco, is an eruptive rock intrusive in sandstone. It was originally a lherzolite, which by the usual processes of alteration has been changed to serpentine. Two varieties of the rock are noticed by Palache.[2] One is a massive form, while the other is slickensided along so many planes close together that the rock has became schistose. Between the slickensided surfaces are often spheroidal masses of the massive rock. The massive serpentine is of the usual character. It consists now of a felt of serpentine fibres in which are imbedded numerous crystal-like areas of enstatite and diallage, and grains of olivine, magnetite and chromite. The crystal-like particles of the pyroxenes are remnants of larger grains that were shattered by dynamic action. The pyroxenes and the olivine have yielded the serpentine. Intrusive into the serpentine is a hypersthene diabase, composed of labradorite, monoclinic and orthorhombic pyroxenes and green hornblende, supposed to be derived from the pyroxene. Its structure is ophitic. A second variety of the rock consists essentially of plagioclase and hornblende. Portions of it are schistose. Its structure is sometimes granitic and sometimes ophitic, and in the latter case it contains small quantities of pyroxene. Hence it is regarded as an altered form of the diabase. An analysis of the hornblende variety follows:

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	P_2O_5	TiO_2	H_2O	Total
47.41	16.03	2.66	7.05	tr	12.33	5.81		4.47	tr	1.29	2.19	=99.24

Density = 2.96.

The Blue Hornblende in the California Schists.—In many of the schists of the Coast Range, Cal., is a blue amphibole that has for some years past gone under the name of glaucophane. Palache[3] has recently found it in large quantities and in well developed columnar crystals in a schist-boulder near Berkely. The matrix of the schist is a granular aggregate of clear, fresh albite, containing numerous liquid and solid inclusions. The latter consist largely of small grains

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Maine.

[2] Bull. Geol. Dept. Univ. of Cal., Vol. 1, p. 161.

[3] Ib., Vol. 1, p. 181.

and needles of the blue amphibole. In addition to these are tiny crystals of magnetite, sphene and zircon. In this matrix lie sheaves of the blue amphibole, which are formed of small needles or of large columnar crystals, sometimes measuring as much as 20 mm. in length. The crystals are well developed in the prismatic zone, where they exhibit clearly the cross section of amphibole. The plane of their optical axes is the clinopinacoid. The extinction of the mineral is about 13° to *c*, along the axis of greatest elasticity. The mineral must be closely related to riebeckite. A characteristic feature of the new amphibole is its strong pleochoism, which is stronger even than that of glaucophane. A=sky blue to dark blue; B= reddish to purplish-violet; C= yellowish-brown to greenish-yellow. When broken, crystals of the blue amphibole are often healed with green actinolite, and often fibres of the latter mineral unite portions of blue crystals on opposite sides of veins of albite cutting through the rock mass. An analysis of the blue mineral gave:

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	H_2O	Total
55.02	4.75	10.91	9.46	tr	9.30	2.38	7.62	.27	undet.	= 99.70

This indicates a mixture of the three molecules $Na_2\ Al_2\ Si_4O_{12}$, $Na_2\ Fe_2''' \ Si_4O_{12}$ and $R''SiO_3$ (where R is Mg : Ee : Ca = 6 : 2 : 1) in the proportions 1 : 2 : 9. The optical properties of the mineral are very similar to those of the blue amphibole described by Cross.[4] Chemically, it lies between riebeckite and glaucophane. The author names it crossite.

The Diorites, Gabbros and Amphibolites of Argentina.—The basic rocks from Argentine in the collection of Berlin University have been studied petrographically by Romberg.[5] They occur in the easternmost of the Cordilleran chains, associated with crystalline schists and eruptive rocks. The diorites and gabbros form stocks, and sometimes sills and dykes, that are closely associated with gneiss and crystalline limestones. The author divides the rocks studied into a number of groups and sub-groups, recognizing as the two principal groups eruptive rocks, and those associated with the crystalline schists. Among the undoubled eruptives are gabbros and diorites, and of the latter class there are two varieties, the diorites proper and the quartz diorites. Gabbro-diorites are also recognized among the specimens. The gab-

[4] Cf. American Naturalist, 1890, p. 1073.

[5] Neues Jarb. f. Min. etc., B. B., ix, p. 293.

bros include olivinitic and non-olivinitic varieties. In the former there is often a bluish-green hornblende, at whose contact with feldspar there is often a fringe of spinel arranged in pseudopodia-like masses with their long directions perpendicular to the bounding surfaces of the amphibole. In other specimens the olivine is separated from feldspar by a band of hypersthene. Norites, with reaction-rims around their olivines, and peridotites containing enstatite are among the other members of the gabbro family met with. More closely associated with the schists than all the rocks just mentioned, and apparently forming a portion of the schist series, are diorites, often saussuritized, and amphibolites among the hornblende rocks, and gabbros, peridotites and serpentines among the pyroxene bearing kinds. The basic schistose rocks in the collection studied are schistose diorites, and rocks composed essentially of epidote and zoisite, and of garnet and scapolite, supposed to be derived from diorite, schistose gabbros and hornblende schists. After describing the characteristic features of the gabbro and diorite structures, the author proceeds to discuss the origin of the Argentine hornblende schists. He finds no evidence that these are squeezed plutonic rocks nor metamorphosed sediments, and so he concludes that they are submarine eruptives.

Amphiboles in Russian Rocks.—Federow[6] gives some interesting notes on the amphiboles in the rocks of the northern Urals. The mineral is frequently absent from the freshest rocks. It is most abundantly present in those that have been metamorphosed by pressure. The kinds observed were a yellow-green variety, a colorless or very light colored kind, a dark brown variety, a fibrous variety with a blue color, glaucophane and gastaldite. The first is especially common in gneiss, syenite and syenitic gneiss, and it is present also in a diabase, where it is believed to have been derived from chlorite. The second variety is common to highly metamorphic rocks, while the third is limited to diabases and proterobases. The fourth variety is characteristic of the green schists, more particularly those that have undergone chemical alterations. The glaucophane is found in magnetite schists, in a few altered green schists and in gneiss. The sixth variety is also common to the green schists. In a syenite gneiss the author observed a brown augite that along a zone of crushing has been changed to a light green pyroxene, which is regarded as evidence that dark brown amphibole may give rise by pressure to light green hornblende.

[6] Minn. u. Petrog. Mitth., xiv, p. 143.

Basalt Boulders from Thetford, Vt.—A brief description of the material of the peculiar basalt boulders discovered by Hubbard at Thetford, Vt., is given by Hovey[7] in a recent paper. The most conspicuous features of the boulders are the large masses of olivine and pyroxene scattered through them. The former are in rounded aggregates with a granular structure. Their composition is $SiO_2 = 40.75$, $FeO = 9.36$; $MgO = 50.28$. The pyroxene nodules consist of the remnants of single crystals of a pale green color, and with an extinction of 44°. These nodules are in a groundmass composed of augite, plagioclase, hornblende and several accessory substances. The augite of the groundmass is brownish-violet in color, and it has the peculiarities of basaltic augite.

Maryland Granites.—Keyes[8] argues the original character of much of the epidote in Maryland granites from its close association with allanite, which is believed to be an original component of the rocks, since it occurs in them as sharply defined crystals completely mantled by fresh biotite. It is found also included in crystals of sphene of whose primary nature there can be no doubt. Finally its grains are idiomorphic with respect to many of the original rock components with which they are in contact.

[7] Trans. N, Y. Acad. Sciences, xiii, p. 161.
[8] Bull. Geol. Soc. Amer., Vol. 4, p. 305.

GEOGRAPHY AND TRAVELS.

Zoological Explorations in the Far North.—There is rejoicing at the State University of Iowa over the safe return of Mr. Frank Russell, after two and a half years' absence in the far north, where he has been engaged in zoological explorations.

Mr. Russell undertook to secure series of specimens of the larger mammals, besides birds, ethnological material, etc., from the less accessible parts of North America embraced in the region between Lake Winnipeg and the Arctic Coast. His explorations were made under the auspices of the State University of Iowa, from which institution he graduated in 1892.

Arriving in August, of 1892, at the mouth of the Saskatchewan River, on the northwest shore of Lake Winnipeg, he spent the first winter in securing series of moose, northern hare, ptarmigan, etc., and also became accustomed to the management of dog sleds and snow-shoes, thus securing the necessary training and experience for the more serious work of the succeeding year. Voluminous notes were taken of the fauna of the region, and much information secured concerning the folk-lore and religious customs of the Swampy Cree Indians.

In February, of that year, Mr. Russell traversed the length of Lake Winnipeg, some three hundred miles, on snow-shoes, experiencing some of the coldest weather met with during his entire trip. From Winnipeg he went to Fort McLeod, near the foot-hills of the Rocky Mountains, just north of the boundary line, where six weeks were spent in collecting mammals and birds. Returning by rail to Edmonton, he traveled overland to Athabasca Landing and then descended the Athabasca River in a York-boat, with some officers of the Hudson Bay Company, reaching Fort Chippewyan, on Lake Athabasca, May 15th. A month was spent on the shores of the lake in securing a series of the birds of that region, the collector camping out alone during the entire time, living in a little "A" tent, and seeing but one man—a Cree Indian.

Early in July, our explorer proceeded down the Slave River to Great Slave Lake, reaching Fort Rae, on the northwest extension of the lake, early in August. This point was his base of operations until May of the succeeding year. During his various hunting trips from this center, he explored the vast and little-known territory around the Great Slave Lake, in some cases reaching points at least four hundred

miles from the Fort. During the winter, he traveled between twenty-one and twenty-two hundred miles on snow-shoes, driving his own dog-team and living, in almost all respects, the life of an Indian. He found it necessary to depend on himself alone, the natives being entirely unreliable. His more important excursions from Fort Rae were as follows:

A trip up the Yellow-Knife River to learn, if possible, something of the summer fauna of Barren Ground, and to secure the services of an Indian who had been recommended as trustworthy, but proved more of a hindrance than an aid.

Next, about five hundred miles were traveled in hunting for the Barren Ground caribou. A sufficient number were killed to secure a large supply of meat, and eleven skins and skulls of selected specimens were added to the collection, which has since arrived safely at Iowa City.

In midwinter, December and January, a long and arduous trip was taken in the hope of securing specimens of the wood buffalo, a variety of the American buffalo which still inhabits the region lying to the south and southwest of the Great Slave Lake. During this trip, Mr. Russell swung around a circle in which the whole of the Great Slave Lake was included, and also the territory for one hundred miles or more to the southwest. No wood buffalo were seen, nor even traces of them, although the very heart of their supposed range was traversed. Mr. Russell heard that two specimens had been killed that winter by the Indians, but they were apparently all that had been seen. He considers the race as almost exterminated, as their range is reported, by the Indian hunters, as very limited.

During March and April our explorer accomplished the main purpose for which he went north, *i. e.*, the capture of a series of musk-ox. The difficulties overcome at this time were such as to demonstrate the fact that Mr. Russell must take rank among the very foremost of plucky and persevering explorers in the far north. The musk-ox were four hundred miles from Fort Rae and two hundred miles from the edge of the woods. The Indians were unwilling to aid the explorer, having a firm belief that if a musk-ox were taken from the Barren Ground, and mounted in some distant country, all the others would go to join it. Those who have had to do with Indian superstition know the hopelessness of arguments, bribes or threats in such cases. Undismayed by this unforseen and seemingly fatal obstacle, Mr. Russell allowed the Indians to depart without him, well knowing that it is their custom to camp on the edge of the Barren Ground for some time for the purpose of killing caribou before going on the long musk-ox hunt, and know-

ing also that they would get out of ammunition and send a man two hundred miles back to the Fort for a new supply. When this messenger made his appearance as expected, Mr. Russell announced his determination to accompany him back to the Barren Ground, *nolens volens.* He persuaded him to make the best of the inevitable and accept pay for the enforced service. This was finally agreed to. Mr. Russell joined a band of the Indians at the edge of the Barren Ground, and accompanied them, driving his own dog-team and running behind the loaded sled until the "Musk-Ox Hills," two hundred miles distant on the treeless Barren Ground, were reached. These "Hills," by the way, he found to be mountains, several thousand feet high, and not far from Bathurst Inlet. The band of Indians separated into two squads, and succeeded in killing about one hundred of the musk-ox, including every one that was seen. The animals were found in comparatively small herds, rounded up by the dogs and mercilessly slaughtered. Mr. Russell killed four that had escaped from the main group as they were running off, and several others at another time. He was allowed five skins by the Indians, although he had killed a much larger number with his Winchester. These were all superb specimens—four males and a female, and, with the heavy horns and massive skulls, they made a sled load of such dimensions that the dog-team, although the strongest of the lot, became so weak before the woods were reached that Mr. Russell had to aid them almost constantly by pushing the sled from behind. Twenty-two days, in all, were passed on the Barren Ground. The explorer thought that about one thousand musk-ox were killed that season by the various bands of Indians who enter the Barren Ground from the south. The Esquimaux also penetrate the same region from the Arctic Coast, and, on one occasion, the Indians and Esquimaux have met. It is therefore evident that the musk-ox of the Barren Ground is doomed to follow the bison of the Plains, and join the rapidly growing list of "mammals recently exterminated."

On May 10th, Mr. Russell left Fort Rae, where he had received the kindest treatment and invaluable aid from the Hudson Bay officer in charge, Mr. Hodgson, and proceeded around the north shore of Great Slave Lake to Fort Providence, which he reached after unusual suffering from hunger and exposure. He found that the north shore of the lake was very inaccurately represented on the maps. At this time he was compelled to leave his faithful dogs with the Indians, although he exceedingly regretted the necessity. On May 25th, he succeeded in reaching a steamer, which had wintered about twenty miles below Fort Providence on the Mackenzie River, and proceeded down as far as

Fort Good Hope, which is almost exactly under the Arctic Circle. From here he paddled alone in a small canoe to Fort McPherson, two hundred and eighty miles farther north. Here he was joined by the celebrated French explorer, Count de Sainville, with whom he kept company for the remainder of his trip. While going to the mouth of the Mackenzie, some hundred and sixty miles below, he killed a grizzly bear as it was swimming the river. From the mouth of the Mackenzie he paddled his canoe through the ice-floes in the Arctic Sea to Herschel Island, a distance of one hundred miles, this being, in all probability, the first time a one-man canoe has ever gone over these waters. Several American whaling vessels had passed the previous winter at Herschel Island, and left two days after Mr. Russel reached that point. He made arrangements with Captain Newth, of the steam-whaler "Jeanette," for transportation to San Francisco, at the end of the whaling season. Two months were spent in making ornithological and ethnological collections on this island and the adjacent mainland, a remarkably fine series being secured.

August 30th, the "Jeanette" returned to Herschel Island and took on board Mr. Russell and his collections. The vessel then sailed to the region north of Wrangel Land, and here the passenger had the pleasure of seeing the process of killing and cutting up a large whale. Turning southward, the "Jeanette" touched at two points on the Siberian Coast, where Mr. Russell secured a monster Polar bear skin and skull, numerous ethnological specimens, and a unique collection of Esquimaux ivory work, graved, etched and colored, besides a pair of enormous walrus tusks. After a very rough voyage, the vessel entered the Golden Gate on October 27th, bearing the two passengers who had been the first men to traverse the vast length of the Athabasca, Slave and Mackenzie basins to the coast, returning to civilization by way of the Arctic Sea, Behring Straits and California.

Mr. Russell's collections have all been received in excellent condition, and constitute probably the finest series of zoological and ethnological specimens which have thus far been brought from the far north by any one explorer.

C. C. Nutting.

BOTANY.[1]

The Wild Flowers of America.[2]—When Dr. Goodale and Isaac Sprague gave to the world, a dozen or more years ago, their magnificent work entitled the "Wild Flowers of America" no one then supposed that within a few years the title would be disgraced by such a work as we have now before us. In spite of the extravagant claims upon the title page, as to the "special artists and botanists" who are said to have prepared it, and the "leading artists of America and Europe who are said to have approved it, as well as the "university botanists of both continents" whose "endorsement" is alleged, we venture to affirm that no one with any artistic ability whatever, or even the slightest knowledge of the science of botany, could "approve" or "endorse" the hideously inartistic monstrosities here gathered together. We are not told who the "special artists" are, nor is the identity of the "botanists" revealed to us, but the publishers assure us that these unknown persons gave "years of unwearied toil, careful research and immense expenditure" to the gathering of the material! The publishers further state that the work was originally intended for "public institutions, universities and laboratories," but that "at the solicitation of some of the principal educators of the country" they have brought out an edition on "a popular basis." They speak of its "enormous educational value," and urge that school teachers and school children should be supplied with it. Finally, they connect the name of the American Association for the Advancement of Science with the work in a most unwarranted way.

Now what is the work so loudly praised by its publishers? It is a collection of very poorly drawn pictures of flowers, very badly colored. They have no botanical value, and to the non-botanical they are misleading, both in form and color. When one attempts to read the so-called descriptions, the extreme illiteracy of the author is as evident to the ear as the lack of artistic ability in the "artists" was plain to the eye. There is nothing like it anywhere. It is positively the worst piece of work all around that we have ever seen offered to the American people.—CHARLES E. BESSEY.

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

[2] Botanical Fine Art Weekly.—Wild Flowers of America, published by G. H. Buek & Co, New York. Flowers of every state in the American Union, by a corps of special artists and botanists. Approved by the leading artists of America and Europe, and endorsed by university botanists of both continents.

Willis' Practical Flora.[3]—We are told in the preface of this well printed, and rather attractive book that "to engage the interest and enthusiasm of such students [elsewhere stated to be those without a scientific mind] it is necessary to show the practical aspects of the vegetable world, and its relations to the needs of everyday life," etc., and that there has been a long felt want for a work of such practical character, and this book has been prepared to meet the demand." This assigns the work to a peculiar class, and practically takes it out of the domain of scientific botany. If other teachers find it necessary to use devices such as the author suggests in his preface, perhaps no one but the friends of the unfortunate pupils need make objection. It may be well to say here, however, that such matter as is here presented is not botany, at any rate not the botany of this last decade of the nineteenth century. On looking over it one is carried back fifty years or more to the time when botany was little more than the handmaid of materia medica, horticulture and agriculture. Instead of bringing out a new book, the author has given to the American public a very old kind of book, including a very old kind of botany. Possibly in some of the ultra "practical" agricultural schools of the country it may supply "a long felt want," but it is scarcely probable that it will find a place in schools in which any pretence is made of teaching the *science* of botany.

Passing to details, one is puzzled to make out the principle upon which the plants described were selected. We find ten species of *Anemone* (all wild), nineteen of *Ranunculus* (sixteen wild), six of *Clematis* (wild), etc., etc., and yet there are no Water Lilies, Basswoods (*Tilia*), Rue, Hollies or Virginia Creepers. Yet, seven species of *Rhus* are given, in spite of the fact that but one Maple (the Sugar Maple) is given. The student might well ask also why the author omitted from the species of *Prunus* all mention of *P. americana*, the more commonly cultivated plum in the central United States. The cactuses are unnoticed, while of coffee (*Coffea*) thirty-five "species"! But five genera of *Compositæ* are given, viz.: *Inula, Anthemis, Chrysanthemum, Tanacetum* and *Carthamus.* Not a word is said about Asters, or Golden Rods, Dahlias or Thistles, nor is there anything about Artichokes, or Arnica even. The Olive is described, but not the Ash

[3] A Practical Flora for Schools and Colleges, by Oliver R. Willis, A. M., Ph. D., Instructor in Botany, Physics and Chemistry in the New York Military Academy. New York, Cincinnati, Chicago. American Book Company [1894]. pp. xvi, 349, 8vo.

trees, yet we find the Tomato, Tobacco, Pepper and Potato. It is odd, too, to say the least, that in a treatment of the Conifers which includes *Pinus monophylla* (which, by the way, the anthor confuses with other nut pines ")no mention is made of *Pinus ponderosa*, *P. lambertiana* or *Pseudotsuga taxifolia.* Of the illustrations little need be said, more than that many of them are " trade cuts " from the catalogues of seedsmen, many of them possessing the characteristic exaggeration of such cuts. The figure of Indian Corn on page 287, with *fourteen ears*, will not tend to give one confidence in the truthfulness of the illustrations. —CHARLES E. BESSEY.

ZOOLOGY.

The Sensory Canal System of Chondrosteans—Collinge has studied especially Polydon, Psephurus and Acipenser. He cannot assent to naming every branch a canal but prefers to consider sensory organs, pits, pores, canals, etc., as parts of one sensory canal system. In this we have to distinguish the canals, the parts of which are named. The term cluster pores (=peripheral organs of allis) is given to the pores of fine dermal canals running from the main canals or branches; the pinhole pores of many authors are called primitive pores from the fact that they occur on the most generalized forms. Unbranched canals radiating from certain centres on the head, and with an ampulla near the proximal end are called ampullary canals. All of the different kinds of sensory organs are grouped under that name. The system in Polyodon is described for the first time. It contains all the structures except the ampullary canals, which have not been found except in Elasmobranchs. The parts are described with some detail, as is also their innervation. In the matter of the cranial nerves many corrections and additions are made to Van Wijhe's well-known description, especially in regard to the ramus oticus of the trigeminal and the ramus mandibularis of the facial.

Psephurus agrees pretty well with Polyodon but Acipenser is very different. The first two show marked Elasmobranch features while the latter has Teleostean tendencies. Collinge is inclined to support the validity of the group Ganoids and to accept its division into Selachioid and Teleostoid groups, the Acipenseridæ serving to connect the two. While the canal system in its broader features seems to confirm, in this respect, the evidence obtained from other organs, Collinge doubts if it can be employed in any except the most general manner.

The Hypophysis.—Lundborg has studied the hypophysis in teleosts and batrachians and concludes[1] that it arises as a paired structure from the deeper or nervous layer of the ectoderm, its two halves later fusing. At first there is an hypophysial stalk, short and solid, which later disappears. The future growth is one of folding, etc. The glandula infundibuli are later in arising from the infundibulum and a vertical communication always exists between infundibulum and gland.

[1] Zool. Jahrbücher, Abth. Anat. u. Ont., vii, 1894.

At first the gland consists of a single layer of round embryonic cells but it later becomes differentiated into two cell layers, the one of large capsular cells, the other of smaller triangular cells which lie between the apices of the others. Nothing new is given regarding the phylogeny of the organ.

The Species of Bothriocephalus.—From a recent article by R. Blanchard[2] the following key may be compiled as an index to the species of the collective genus *Bothriocephalus*:

1	Genital organs single	2
	Genital organs double	4
2	Genital openings lateral (marginal),	*Bothriotænia* Railliet, 1894.
	Genital openings ventral or dorsal, ...	3
3	Penis, vulva and uterus open ventro-median, . . .	*Bothriocephalus* Bremser, 1819.
	Penis and vulva ventro-median; uterus opens dorso-median, .	*Ptychobothrium* Lönnberg, 1889.
4	Penis, vulva an uterus open ventrally,	*Krabbea* R.Bl., 1894.
	Penis and vulva ventral; uterus opens dorsally, . . .	*Diplogonoporus* Lönnberg, 1892.

Bothriotænia, type species *B. longicollis* (Molin), contains besides the type species, *B. fragilis*, *B. infundibuliformis*, *B. rugosus* and *B. suecicus*.

Bothriocephalus (type *B. latus*) contains *B. latus*, *B. cordatus* and *B. cristatus* found in man; a large number of species found in mammals, birds, reptiles and fishes.

Ptychobothrium contains *Pt. belonis*, *claviceps* and *punctatus* found in fishes.

Krabbea is founded upon a large 10 m. tapeworm recently found by Ijima and Kurimoto (Journ. Coll. Sc., Tokyo, 1894, IV, pp 371–385, Pl. XVIII) and contains besides this type *Kr. fasciata*, *Kr. variabilis* and probably *Bothriocephalus tetrapterus* and *B. antarcticus*.

Diplogonoporus Lönnberg, 1892 (=*Amphitretus* R.Bl., 1894) contains *A. wagneri* (Monticelli) and *A. lonchinobothrius* (Monticelli).—C. W. Stiles, Washington, D. C.

Batrachia of Vincennes, Indiana.—The following list of the Urodela found in the vicinity of Vincennes, Ind., includes only such

[2]Notices sur les Parasites de l'Homme: iv, Sur le *Krabbea grandis*, et remarkes sur la classification des Bothriocéphalinés; Compt. rend. Soc. Biol, 1894,

as I have captured myself. I have often assisted in draining ponds and clearing swamps and have secured many specimens in that way. I have also been a laborer for many years in a sawmill and often find eggs, larvæ, and even adult animals in the cracks and hollows and under the bark of logs drawn into the mill from the Wabash. I have at various times kept, or attempted to keep almost all the animals named here in captivity.

Siren lacertina (Linn.). Has no local name, being rare. The only specimen I have found was taken in midwinter from the hollow of a log that was rather rotten and filled with mud. I kept it in a barrel partly filled with mud and water. Being neglected, this was frozen over and had to be transferred to the cellar. When it finally thawed out the Siren appeared in no ways injured, but uttered a whistling hiss when touched and ate scraps of meat voraciously. It would eat earthworms and putrid meat, and on one occasion ate a lizard. I once put two laths down in the barrel and on the next day found my pet squirming about on the cellar floor, demonstrating that it could climb a little. It spent most of its time buried in the mud and I rarely saw it without first digging it up. In the eight months that I kept it it made no perceptible growth, yet it ate readily whenever it was dug up and fed. My last experiment was feeding it rancid bacon which it ate with a relish, but it died that night and I concluded that the salt had killed it.

Cryptobranchus alleghaniensis (Daudin). Probably rare in this locality. The only one that I have seen was 17 inches long, of dark slate color. Its bite left severe scratches.

Necturus maculatus (Raf.). Our commonest salamander. It will eat any kind of animal food. I have read of their biting but could never induce them to do so. Their eggs, laid about the middle of July, are about the size of peas and are quite transparent, offering the best possible material for the study of batrachian embryology. I have found them with their gills missing, apparently bitten off, but have met with no explanation and have none to offer.

Amblystoma microstomum (Cope). Common in stagnant pools. A gentle little creature that likes to be scratched or stroked with a feather, and soon learns to take earthworms from the fingers. Its legs are apparently weak, yet it can climb out of an empty tub or bucket. I have seen the larvæ leave the water.

Amblystoma tigrinum (Green). Repulsive and bloated in appearance. Adults of livid blue-black color with back covered with yellow spots which blend upon the belly, almost covering the surface. I have

seen the newly hatched young, scarcely more than half an inch in length, feeding upon aquatic animals and even eating coleopterous insects with their hard wing cases.

Amblystoma punctatum (Linn.). Slate color, with a row of 7 or 8 yellow spots on each side of body and similar rows on the tail. I kept a female that ate larvæ and earthworms and grew to over 7 inches. She deposited a large number of eggs imbedded in a mass of rather hard jelly, but they did not hatch, not having been fertilized by the male. She swam with her tail alone, holding her legs motionless by her side. When not disturbed she spent much of her time floating on the surface of the water. Her tail was prehensile.

Amblystoma opacum (Gravenborst). A sluggish animal. I have never seen the adult enter the water.

Hemidactylium scutatum (Schlegel). Brown colored, and rough-skinned. I have seen small ones, but never any with gill slits and have never seen it in the water. Like *A. punctatum* it has a prehensile tail.

Plethodon cinereus (Green). Black-backed. Numerous in swampy ground.

Plethodon erythronotus. Straight red stripe on back. Quick and active. I have seen them climb the glass sides of a show case in which they were confined.

Plethodon glutinosus (Green). Wet, stony ground. Apparently terrestrial, though it is a good swimmer. The prehensile power of its tail is the most highly developed of all of our native Salamanders.

Spelerpes longicaudus (Green). It makes an entertaining pet, for it is beautiful and active, takes food readily and moves with an absurd series of wriggles and jerks. The only specimens I have seen were found under logs on the top of a hill, far from water. I kept them in a box of wet moss and they flourished, but some kept by a friend in a dry box, supplied with a little pan of water, soon died.

Spelerpes maculicaudus (Cope). Rare, found beneath overhanging rocks.

Spelerpes bilineatus (Green). They are active, are good climbers and can *jump*.

Diemyctylus viridescens (Raf.). Common, easily domesticated. Active all the year, even when their ponds are frozen over. They have prehensile tails.

Desmognathus fusca (Raf.). Some years ago they were common under stones in Kelso Creek, near Vincennes, but now, with better

drainage, that creek goes entirely dry in the summer and they are, I think, entirely extinct.—Angus Gaines.

List of Snakes Observed at Raleigh, N. C.—1. *Ancistrodon contortrix.* Copperhead. Rather common here in the wet meadows, although universally known and recognized as the "Highland Moccasin."

2. *Ancistrodon piscivorus.* Our only specimen of the "Cottonmouth" was killed on Neuse River in the summer of 1891, and in bulk was one of the largest snakes we ever killed here. The length was, I think, 40 inches, although I have unfortunately lost the data connected with it.

3. *Heterodon platyrhinus.* "Spreading Adder." Common; the black variety is quite rare.

4. *Ophibolus getulus.* "King Snake." Common; feeds largely and I think usually, on other snakes, even its own species. I forced one to disgorge a meadow mouse a few weeks ago, otherwise its record of snakes for food is unbroken in my experience. It is popularly supposed to be excessively venomous and is also alleged by some to have a sting in its tail which it uses when angry.

5. *Ophibolus doliatus.* Rather rare; the specimens we get here agree in color with vars. *syspilus* and *coccineus.*

6. *Ophibolus rhombomaculatus.* Rather rare. Feeds on rats and mice judging from the few stomachs examined. Large specimens have the markings very obscure, being nearly uniform in color above. Our largest recorded specimen measures 42 inches.

7. *Cemophora coccinea.* Rare.

8. *Bascanium constrictor,* the Black Snake, is quite common here and is the most courageous of our snakes, freqnently standing its ground and fiercely striking at an intruder. It occasionally, at least, eats other snakes.

9. *Coluber obsoletus.* "Chicken Snake." Not very common. This is the snake most frequently found ascending trees here and so it presumably feeds more on birds than any other. It is also the largest (longest) of our snakes, our largest recorded specimen measuring 74 inches.

10. *Coluber guttatus.* Quite rare here, only two specimens so far collected.

11. *Cyclophis æstivus.* Quite common, particularly in bushes in the low grounds. For some unexplained reason it is popularly considered as extremely venomous.

12. *Diadophis punctatus.* Rather scarce. The few I have personally taken have usually been near the water.

13. *Natrix sipedon.* Our commonest and in bulk our largest snake. Commonly known as "Water Mocassin." We sometimes get specimens uniform dusky above, uniform reddish below.

14. *Regina leberis.* Rather rare. We kept a female this summer for some time, till at last she gave birth to 13 young ones from 7¼ to 8 inches long.

15. *Storeria occipitomaculata.* Rather rare.

16. *Storeria dekayi.* Quite common.

17. *Eutainia sirtalis.* Common. Eats frogs, toads and sometimes, at least, small snakes.

18. *Eutainia saurita.* Common. Lives on small frogs and salamanders to some extent.

19. *Haldea striatula.* Common.

20. *Virginia valeriæ.* Quite rare, only seven specimens taken so far.

21. *Carphophiops amœnus.* Common. This and the two preceding are found under logs in the woods and are also sometimes ploughed up.—C. S. Brimley.

An Abnormal Pes of Columba livia.—During the winter of 1893 I came across a half-bred fantail pigeon whose left pes (Fig. 3) showed a pentadactylous condition. The right pes (Fig. 4), though apparently normal, revealed on dissection, in addition to the free hallux metatarsal element, an extra free metatarsal-like element which was placed median to the hallux metatarsal (Fig. 2).

In the left pes (Fg. 1) there are instead of a normal hallux two separate claws, two parallel phalanges with free ends but fused in the middle region, the proximal free ends articulating with a bilobed metatarsal which is ankylosed to the median surface of the proximal half of the conjoint metatarsals.

In a left pes of a common pigeon given to me by Mr. G. S. Miller, Jr., there were instead of the hallux, two closely appressed clawed phalanges articulating with a metatarsal which was not ankylosed with the conjoint metatarsals. Between this metatarsal and the second digit was apparently a small sixth digit with a well developed phalanx and claw.

S. D. Judd, Peterboro, N. Y.

Explanation of Figures, Plate I (Columba livia).

Fig. 1. Ventral view of the skeleton of the left pes, XI.

Fig. 2. Ventral view of the skeleton of the right pes in part, XI.

Fig. 3. Ventral view of the left pes, XI.
Fig. 4. Ventral view of the right pes, XI.

Zoological News. Invertebrata.—Students of American forms will find much of interest in Garstang's "Fuanistic Notes at Plymouth."[3] Especially interesting are the notes on the synonymy of the Medusæ, the existence of budding in the Lucernarians, and the notes on the floating fauna, as obtained in the skimming net.

Echinoderms.—After a zoological silence of several years, Prof. A. E. Verrill takes up the Starfishes and Brittle Stars, describing[4] some of the species obtained by the U. S. Fish Commission and revising some of the previously described forms. Two new sub-families, two new genera and 15 new species are characterized; some pertinent criticisms are made on some of Sladen's family characters and a consistent revision is given of the ossicles commonly called paxillæ and pseudopaxillæ.

Worms.—Andrews describes[5] some abnormal annelids, in which the caudal extremity of the body is forked, supplementing a previous paper (this journal, p. 725, 1892). The ten cases described agree in that in all the main axis of the body and all appendages are duplicated. As to the cause of such monsters little definite can be said. It seems probable, however, that they may be produced from adults. After some remarks on regeneration, Dr. Andrews concludes that "here we may suppose that injuries and other external agents affect the regenerative tissue so that the same cells that else had formed one normal terminal now form two more or less separate ones."

Crustacea.—C. D. Marsh describes[6] two new species of Diaptomus, one from Mississippi, the other from Wisconsin.

Mr. Edgar J. Allen has just published[7] three of the most careful pieces of work as yet done on the histology and physiology of the nervous system of the Crustacea. The work was carried out on the lobster by means of the Methelyne blue and the rapid Golgi methods. Among the points brought out are the recognition of these nerve ele-

[3] Journ. Biol. Assoc. United Kingkom, iii, 210, 1894.
[4] Proc. U. S. Nat. Mus., xvii, 245, 1894.
[5] Quarterly Jour. Micros. Sci., xxxvi, 435, 1894.
[6] Trans. Wisc. Acad. Sci. and Arts, x, 1894.
[7] Quar. Jour. Micros. Soc., xxxvi, 461, 1894.

ments: 1. Co-ordinating elements which lie entirely in the ganglionic chain. 2. Motor elements in which the ganglion cell is in the chain, the fibre running out at a lateral root. 3. Sensory elements, consisting of cells outside the chain and fibres running from them to the chain. The stomatogastric nerve is also studied and the beading of nerve fibres, etc., is discussed.

Arachnida.—Emerton has gathered several collecetions of Canadian spiders and publishes[8] a list with annotations and descriptions of new species. The close similarity of the Canadian fauna with that of New England is noted. "Out of 61 species, from Labrador to Manitoba, 56 species live in New England; and out of 48 species from the Rocky Mountains, 27 have been found in New England."

Hexapoda.—M. H. Wellman has studied the prothorax of Butterflies[9] and finds that four different types of structure, corresponding to the four recognized families, exist. In the first (Nymphalidæ) the chitinized dorsal lobes of the prothorax are large, almost filling the space between the head and mesothorax. In the second class (Papilionidæ) the dorsal lobes are smaller while the scutellum has increased in size. This class is capable of division into three groups. In the Lycænidæ, the third class, the prothorax is very narrow, and the parts inconspicuous. In the last (Hesperiidæ) the lobes are scale-like.

W. A. Snow publishes[10] a synopsis of the American Platypezidæ. This Dipterous family is rare in America, but in an expedition to New Mexico the University obtained seven species, six of which are regarded as new.

Fishes.—Eigenmann and Beeson publish[11] a revision of the Pacific coast species of the Sebastinæ. The outline of the classification adopted was published in this journal for July, 1893.

E. W. L. Holt continues[12] his North Sea investigations. The subjects treated are (I) the destruction of immature fish, especially of plaice, haddock, and cod. He shows that great injury is being done. (III) A differentiation of a new species of ray (*Raia blanda*). (IV)

[8] Trans. Conn. Acad. Science, ix, p. 400, 1894.

[9] Kansas Univ. Quarterly, iii, 137, 1894.

[10] Kansas Univ. Quarterly, iii, 143, 1893.

[11] Proc. U. S. Nat. Mus., xvii, 375.

[12] Jour. Biol. Association United Kingdom, iii, p. 169, 1894.

The recessus orbitalis, an accessory visual apparatus in flat fishes. This consists of a diverticulum of the orbital cavity, innervated by the facialis, and is supposed to play a part in the protraction and retraction of the eye. (V) A description of a sole with symmetrical eyes. (VI) The reproduction of the Scad (*Caranx trachurus*) which oviposits in May, the eggs being pelagic and containing an oil globule, the yolk being broken up into spherules. (VII) A dwarf variety of the Plaice in which it appears that the forms with ciliated scales are males, those with smooth scales females.

J. T. Cunningham describes[13] the young stages of *Zeugopterus punctatus* in which he discusses the relation of various Pleuronected young. He also describes the experiments carried on in the Plymouth laboratory in rearing fish larvæ.

Evermann has been studying the salmon fisheries of the Columbia River basin and clearly shows[14] that extensive damage has already been done by over fishing and especially by fishing throughout the whole of the run. The commissioner suggests the stoppage of fishing during September and October, by laws passed by all of the states interested. A valuable annotated list of all the fishes collected is given in which several new species are described.

Batrachia.—Grönberg and von Klinckowström publish[15] an account of the structure of the Surinam Toad, *Pipa americana*. Integument, including the pouches for the young, digestive, respiratory, urogenital, nervous and vascular systems are described.

Reptilia.—As a result of an osteological investigation Baur concludes[16] that the genus Anniella must be placed in a separate family, very close to the Anguidæ, and has its closest relative in Anguis itself. Figures are promised in a forthcoming paper on the morphology of Amphisbænia.

Dr. Einar Lœnberg of the University of Upsala, spent nearly a year collecting in Florida. A list of Reptiles and Batrachians col-

[13] Jour. Biol. Assoc., iii, 202, 1894.

[14] Rept. Commiss. of Fish and Fisheries on Investigations in the Columbia River Basin, Washington, 1894.

[15] Zool. Jahrbücher. Abth. Anat., vii, 1894.

[16] Proc. U. S. Nat. Mus., xviii, 348, 1894.

lected has now been published.[17] No new species are described. The notes on the poisonous character of *Elaps fulvius* are interesting.

Birds.—Menke catalogues[18] the birds of Finney Co., Western Kansas. Three species are added to the fauna of the State: *Carpodacus frontalis, Piranga ludoviciana* and *Hesperocichla nævia.*

Ridgway describes[19] *Zosteropes aldabarensis, Z. gloriosæ, Cinnyris aldabarensis, C. abbotti, Centropus insularis* and *Caprimulgus aldabarensis,* from Islands of the Malagassy region. In the same volume[20] he adds twenty-two new species to the Avian fauna of the Galapagos Islands.

Mammals.—True describes[21] as new species of North American mammals, *Sciurus aberti concolor, Scapanus dilatus, Myodes nigripes* and *Mictomys* (n. g.) *innuitus. Parascalops* is a new genus proposed for *Scalops breweri.* The same author also describes[22] *Sminthus flavus* as new from Kashmir, and from North America[23] four new species of wood rats (Neotoma).

[17] Proc. U. S. Nat. Mus., xvii, 317, 1894.
[18] Kansas Univ. Quarterly, iii, 127, 1894.
[19] Proc. U. S. Nat. Mus., xvii, 371, 1894.
[20] t. c. p., 357.
[21] Proc. U. S. Nat. Mus., xvii, 241, 1894.
[22] tom. cit., p. 341.
[23] tom. cit., p. 353.

EMBRYOLOGY.[1]

Optimum Temperature for Incubation.—M. Féré contributes to the *Journal de l'Anatomie* for July, 1894, the results of some experiments upon hen's eggs incubated at 34°–41°. These seem to have been made with caution and to warrant the author's conclusion that 38° is the temperature at which the smallest number of abnormal developments take place, at least during the first few days of incubation.

By exposing eggs to fumes of alcohol the author finds also that the injurious effects are overcome afterwards, in a larger percentage of cases, if the eggs are incubated at this optimum temperature, 38°, than at any other.

Cell Lineage.—Mr. A. D. Mead has made a comparative study of the cleavage in the polychætous annelids, Amphitrite, Lepidonotus, Clymenella and Scolecolepsis, along the lines marked out by E. B. Wilson in his noted paper upon Nereis. From the preliminary results,[2] those who are especially interested in this group may gather much of importance regarding the exact fate of cells of equal origin in the different species.

It will be of general interest to compare the results, when published in full, with those obtained upon Nereis, for in spite of the resemblances that are so close in this group there seem to be some marked differences, in the axial relations especially. We note that the median plane of Amphitrite corresponds to a plane bisecting two of the first four cells in place of passing between two cells, right and left, as in Nereis.

Fertilization in the Earthworm.[3]—A preliminary account of what promises to be a most valuable contribution is the result of the detailed study of the eggs of the striped earthworm, Allolobophora *fœtida*. The author, Katherine Foot, has studied the processes of maturation and fertilization in some two hundred eggs taken from the cocoons in which they are laid.

It seems that the sperm grows very rapidly just before the eggs are laid, so that one sperm may more than double its length within two

[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts, reviews and preliminary notes may be sent.

[2] Journal of Morphology, ix, Sept., 1894.

[3] Journal of Morphology, ix, Sept., 1894.

hours. These sperms have a long head with a spine at its lip, a middle piece of some length and a long tail. They are found free in the cocoons for some ten minutes after laying and then penetrate the eggs. Several sperms may penetrate a single egg and all act alike in giving rise to peculiar conical areas of disturbance. These are more readily understood from the very interesting diagrammatic figures than from any verbal description. These figures seem to show much that the author does not emphasize regarding the minute protoplasmic phenomena concerned.

The egg gives off two polar bodies after the cocoon is deposited. The first divides into two; the three thus formed subsequently break up into spherical bodies that lie irregularly between the egg and its membrane, as many as ten being found by the time the pronuclei are formed. The number of chromosomes is eleven, in the first maturation spindle, in the first polar body, in the second maturation spindle, in the second polar body, and in the egg after this has been constricted off.

The pronuclei are usually only two and do not present discovered differences.

It is claimed that the nuclei are seen distributed through the cytoplasm of the egg during the formation of the first maturation spindle.

The remarkable structures known as "polar rings" in the eggs of Clepsine are recognized again in this earthworm as peculiar and dissimilar appearances seen at opposite poles when the pronuclei are formed.

Cleavage in Batrachia—A study of the phenomena that actually take place in the cleavage of Amblystoma, Diemyctylus, *Rana palustris*, and *Bufo variabilis* has led Messrs. Jordan and Eycleshymer[4] to views that militate against much of the definiteness regarding the cleavage process that still remains in the text books.

They find that "each egg, as a rule, possesses an individual rhythm of cell-division and the time intervals between the different sets of furrows are substantially the same in the same egg. There is, however, considerable variation between these rhythms in different eggs."

Great variations occur in the way and in the relative time that cells divide, that cleavage planes appear, in fact, they state—"we have found irregularity to be the rule, regularity the exception."

No importance can be attached to any agreement between the first plane of cleavage and the median plane of the resulting embryo, since,

[4]Idem.

owing to extensive torsions and cell shifting, material is brought from one side to the other.

Again, from these studies it seems evident that in these Bratachia there is no such definite cell homology to be traced as in the Annelids.

The tendency of the paper is decidedly iconoclastic; what new generalizations may be built up from such data remains for the future to reveal.

Development of Sponges.—An important but much delayed paper by H. V. Wilson has at length been published.[5]

The author studied the marine sponges, Esperella, Tedania and other genera, in the Bahamas and on the New England coast.

The main body of this monograph of one hundred pages and twelve plates is an account of the formation and metamorphosis of the "gemmules" in the above named sponges.

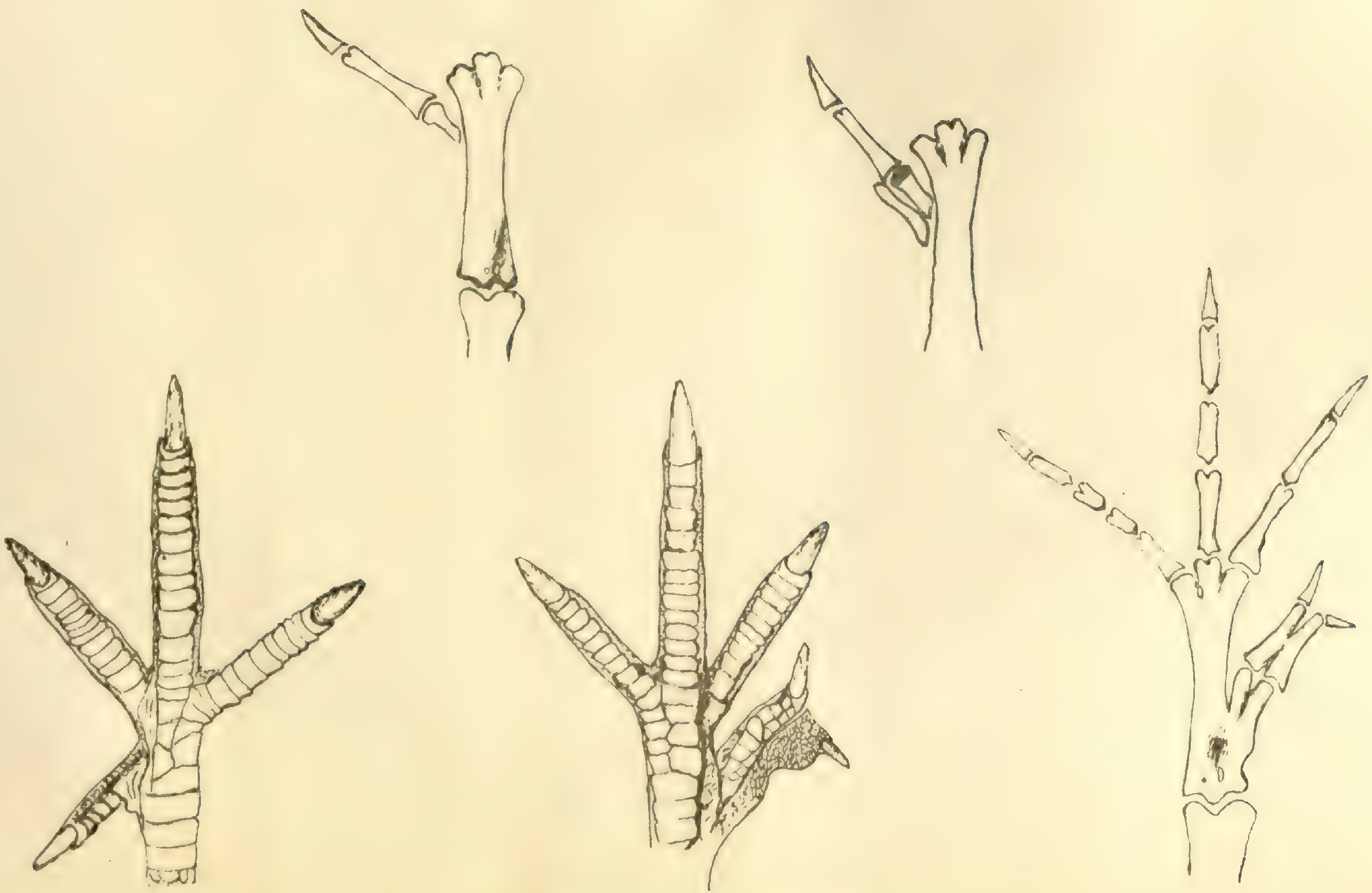
These gemmules in Esperella are masses of cells that contain yolk and may appear anywhere in the mesoderm; they are formed by a collecting of cells to make a central mass or gemmule surrounded by a follicle. As the cells multiply other small gemmules may be added on to make a compound mass that ultimately undergoes a process of separation into the component cells. A free swimming larva is formed by this mass of cells that then escapes from the mother tissue. The outermost cells form an ectodermal layer that is ciliated except at the posterior pole where the cells are flattened and not pigmented as are the ciliated cells. The inner cells are connected by processes and form a parenchyma mass.

This active larva attaches itself obliquely by the posterior pole and undergoes a metamorphosis in which the ectoderm changes into a layer of simple flat cells and the loose cells of the mesodermal parenchyma arrange themselves about inter-cellular spaces, that at first are all alike, but subsequently become the various sponge cavities, subdermal spaces, afferent and efferent canals. These spaces are at first independent and only later become connected. The flaggellated chambers also arise independent of one another and of the other spaces and by a similar process of cell arrangement about intercellular spaces.

These remarkable gemmules closely resemble larvæ derived from eggs and have "germ" layers and the same specialization of the posterior end as is found in the egg larva. This noteworthy resemblance, the author thinks is due to inheritance from a common source and that thus the non-sexual gemmule has retained ancestral traits. No other

[5] Journal of Morphology, ix, Sept., 1894.

PLATE VI.



Abnormal foot of *Columba livia*.

such case is known, unless it be the anomalous mode of hydroid formation in *Epenthesis McCradyi* as described by W. K. Brooks.

In an important discussion of the morphology of sponges, the author, basing his conceptions provisionally upon the generalizations of Haeckel and of Schultze, infers from the comparative anatomy of the group that there was a common ancestor, the Olynthus, which passed into the Sycon state by the outgrowth of radial tubes and this again into the Leucon by the growth of the radial tubes into flagellate chambers and by the growth of new entodermic diverticula. The non-calcareous have come from Leucon-like types. The afferent system of canals is ectodermic; the efferent entodermic.

In the embryology, on the other hand, many abbreviations and other coenogenetic changes have obscured the record of the past. The entoderm and mesoderm must be regarded as not as yet sharply differentiated from one another.

Both sponges and coelenterates probably had a common *solid* ancestor, the Parenchymella. The blastopore cannot be regarded as an ancestral mouth and so its position is not of much weight in deciding how far the cavities of sponges and coelenterates are homologous.

ENTOMOLOGY.[1]

Sight in Insects.—In his recent address as President of the Biological Society of Washington, Dr. C. V. Riley[2] said: "Of the five ordinary senses recognized in ourselves and most higher animals, insects have, beyond all doubt, the sense of sight, and there can be as little question that they possess the sense of touch, taste, smell and hearing. Yet, save, perhaps, that of touch, none of these senses, as possessed by insects, can be strictly compared with our own, while there is the best of evidence that insects possess other senses which we do not, and that they have sense organs with which we have none to compare. He who tries to comprehend the mechanism of our own senses—the manner in which the subtler sensations are conveyed to the brain—will realize how little we know thereof after all that has been written. It is not to be wondered at, therefore, that authors should differ as to the nature of many of the sense organs of insects, or that there should be little or no absolute knowledge of the manner in which the senses act upon them. The solution of psychical problems may never, indeed, be obtained, so infinitely minute are the ultimate atoms of matter; and those who have given most attention to the subject must echo the sentiment of Lubbock, that the principal impression which the more recent works on the intelligence and senses of animals leave on the mind is that we know very little, indeed, on the subject. We can but empirically observe and experiment and draw conclusions from well attested results.

Sight.—Taking first the sense of sight, much has been written as to the picture which the compound eye of insects produces upon the brain or upon the nerve centers. Most insects which undergo complete metamorphoses possess in their adolescent states simple eyes or ocelli, and sometimes groups of them of varying size and in varying situations. It is difficult, if not impossible, to demonstrate experimentally their efficiency as organs of sight; the probabilities are that they give but the faintest impressions, but otherwise act as do our own. The fact that they are possessed only by larvæ which are exposed more or less fully to the light, while those larvæ which are endophytous, or otherwise hidden from light, generally lack them, is in itself proof that they perform the ordinary functions of sight, however, low in degree. In

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

[2] Insect Life, VII, p. 33.

the imago state the great majority of insects have their simple eyes in addition to the compound eyes. In many cases, however, the former are more or less covered with vestiture, which is another evidence that their function is of a low order, and lends weight to the view that they are useful chiefly for near vision and in dark places. The compound eyes are prominent and adjustable in proportion as they are of service to the species, as witness those of the common house-fly and of the Libellulidæ or dragon flies. It is obvious from the structure of these compound eyes that impressions through them must be very different from those received through our own, and, in point of fact, the late experimental researches of Hickson, Plateau, Tocke and Lemmermann, Pankrath, Exner and Viallanes, practically established the fact, that while insects are shortsighted and perceive stationary objects imperfectly, yet their compound eyes are better fitted than the vertebrate eye for apprehending objects set in relief or in motion, and are likewise keenly sensitive to color.

So far as experiments have gone they show that insects have a keen color sense, though here again their sensations of color are different from those produced upon us. Thus, as Lubbock has shown, ants are very sensitive to the ultra violet rays of the spectrum, which we cannot perceive, though he was led to conclude that to the ant the general aspect of nature is presented in an aspect very different from that in which it appears to us. In reference to bees, the experiments of the same author prove clearly that they have this sense of color highly developed, as indeed might be expected when we consider the part they have played in the development of flowers. While these experiments seem to show that blue is the bee's favorite color, this does not accord with Albert Müller's experience in nature, nor with the general experience of apiarians, who, if asked, would very generally agree that bees show a preference for white flowers."

Origin of Reproductive Cells in Insects.—J. W. Tutt discussing the life history of a lepidopterous insect says of this subject:[3] "The earliest development of the ovum and spermatozoon in the embryo of insects is very obscure, but it would appear that the primitive ovaries are composed of a mass of cells, produced by an infolding of the ectoderm; but whilst some writers assert that they arise from the ectoderm, others consider them to be derived from the mesoderm, whilst still others trace their origin back to certain so-called pole cells, which originate even before the blastoderm is formed. However, this

[3] Entomologists Record, V, 246.

may be, it would appear, that they are in that early stage quite indistinguishable from other blastoderm cells.

"Therefore, it would appear, that whilst the great mass of cells become differentiated into various structures which subserve a special purpose, or perform their several functions, certain cells in the ovary retain their primitive condition, and with it the power, under suitable conditions, of forming another individual of the same species. On this subject Mr. Woodworth writes: 'About the time of the completion of the blastoderm, the already differentiated ventral plate infolds at a point on the median line about two-thirds from the upper end, and forms a very narrow pocket. The cells composing it look like the rest of the cells of the ventral plate at this time, they are almost round, and have a lining on one side made of the grey matter which originally bordered the whole egg, but which became a part of the blastoderm cells. The pocket remains open but a short time, but there is a long depresssion of the upper end of the bunch of cells; the mass of cells is soon cut off from the ventral plate and they are then free in the body cavity, but remain in contact with the ventral plate at the point where they were produced. Later stages show that these cells produce the generative organs; the generative organs thus appear to be produced by an infolding of the ectoderm, or possibly of the blastoderm, before the ectoderm is produced, but from a portion which is later to become ectoderm.'"

Alimentary Canal in Orthoptera.—Dr. F. Werner has compared[4] the relative length of the intestine in vegetarian and insectivorous Orthoptera. The result was unexpected. The plant-eating Acridiidæ have a short, almost straight gut, rarely larger than the body; while the Locustidæ have a longer gut usually spirally coiled, especially in Barbitistes and Phaneroptera. Werner believes that the length and coiling of the intestine have nothing to do with the diet, but are correlated with the shape of the body and the habits of life.—*Journal Royal Microscopical Society.*

North American Jassoidea.—Mr. Edward P. Van Duzee has published an excellent Catalogue of the Described Jassoidea of North America.[5] It covers more than fifty pages, and is especially full in bibliography and synonymy. "The classification and arrangement here adopted is substantially that proposed by the author in his 'Synop-

[4] Biolog. Centralbl., XIV, (1894), pp. 116–9.

[5] Trans. Am. Ent. Soc., XXI, July, 1894.

sis' published in these Transactions, Vol. XIX, pp. 296–300, December, 1892. The superfamily term there suggested includes those families in which the hind tibiæ are multispinose. These in our North American fauna are Ulopidæ, Ledridæ, Bythoscopidæ, Tettigoniidæ and Jassidæ. The first of these might perhaps be removed from this series, and the second united with the Tettigoniidæ as a subfamily of equal value with Gyponina and Tettigoniina. The position assigned to the family Bythoscopidæ is purely arbitrary, as it strictly parallels the Jassidæ, to which it is allied by Macropsis, and in a linear arrangement might with equal propriety follow the Tettigoniidæ."

The Use of Parasitic and Predaceous Insects.—There has recently been much discussion concerning the utilization of parasites and predaceous insects in destroying injurious species. A knowledge of the conditions under which such insects act would render it evident that we cannot hope to exterminate any species of noxious insect by means of its parasites alone; and many too sanguine expectations have been aroused. But, on the whole, parasitic and predaceous insects are of immense service to man. Without them many plant feeding species would multiply to such an extent that the production of certain crops would require vastly more effort than it does now. To say, as has been said, that parasitic and predaceous insects have no economic value, is to put the case too strongly. Take, for example, two crop pests of the first class—the army worm and the hessian fly. The history of a century shows that these insects fluctuate in numbers; that there are periods of immunity from their attacks followed by seasons when they are overwhelmingly abundant. It is universally acknowledged that in the case of the hessian fly, this periodicity is due almost entirely to the attacks of parasites, and in the case of the army worm to the attacks of parasites, predaceous enemies and infectious diseases. Remove these checks and what would be the result? The pests would keep up to the limits of their food supply and would necessitate the abandonment of the culture of the crops on which they feed. Take another case: Professor J. B. Smith has argued that "under ordinary conditions neither parasites nor predaceous insects advantage the farmer in the least," and to prove it he cites this instance: "Fifty per cent of the cutworms found in a field early in the season may prove to be infected with parasites, and none of the specimens so infested will ever change to moths that will reproduce their kind. Half of the entire brood has been practically destroyed and sometimes even a much larger proportion; but—and the 'but' deserves to be spelled with capitals—these cutworms will not be

destroyed until they have reached their full growth and have done all the damage to the farmer that they could have done had they not been parasitized at all. In other words, the fact that fifty per cent of the cutworms in his field are infested by parasites does not help the farmer in the least." But obviously it does help the farmer very greatly *the next season*, for it reduces by half the number of cutworms he will have to contend with. As a matter of fact cutworms fluctuate in numbers in a way quite similar to the army worm, and the fluctuations are largely due to parasitic enemies. I have seen regions where cutworms were so abundant that grain fields were literally cut off by them as by a mowing machine, and the following season the worms were so scarce as to do practically no damage. Even the plum curculio and the Colorado potato bettle are sometimes so scarce as to require no protection against them, and presumption is in favor of parasites as a cause of their scarcity.

But Professor Smith is right in saying that as a general rule there is too great a tendency to rely on natural enemies to subdue insect attack. It is nearly always safer to adopt effective measures in keeping pests in check than to trust to the chance of their natural enemies subduing them. As Dr. C. V. Riley has pointed out, "there are but two methods by which these insect friends of the farmer can be effectually utilized or encouraged, as for the most part they perform their work unseen and unheeded by him, and are practically beyond his control. These methods consist in the intelligent protection of those species which already exist in a given locality and in the introduction of desirable species which do not already exist there."

CLARENCE M. WEED.

Oviposition in Acridiidæ.—M. J. Künckel d'Herculais describes[6] the means by which these Orthoptera bury their abdomen in the ground ; there is no perforation of the ground, the hinder part of the body is merely forced into it ; as the Arabs say the female "plantent." On dissecting females whose abdomen had reached the maximum of distension, the author was surprised to find that the abdomen was filled with air; on the air being withdrawn, the abdomen was reduced from 8 to 5 cm. in length. When the position is firmly taken up the females of the migratory locust maintain the parts of their genital armor as widely separated as possible, and secrete a viscous material which agglutinates the grains of sand, or the particles of earth at the bottom of the cavity, and they then begin to lay their eggs. These

[6] Comptes Rendus, CXIX, 1894, pp. 244–7.

and the viscous material are emitted simultaneously, but the latter is peripheral and so consolidates the walls of the cavity which has the curved form of the abdomen. When the eggs are laid the viscous material continues to be shed, and on drying forms a stopper which protects the cavity.—*Journal Royal Microscopical Society.*

The Use of Chinch Bug Diseases.—In Bulletin No. 5 from the office of the State Entomologist of Illinois, Professor S. A. Forbes summarizes the results of years of careful experiment with the white muscardine disease of the Chinch Bug as follows:

1. The white muscardine will not spread among vigorous chinch bugs in the field in very dry weather to an extent to give this disease any practical value as a means of promptly arresting serious chinch bug injury under such conditions. It may be added that chinch bugs are usually vigorous in dry weather.

2. It is most likely to "catch" in low spots, where the soil is kept somewhat moist by dense vegetation, a mat of fallen herbage, or the like. Shocks of corn, especially when the crop is cut early, furnish excellent places for the development of this disease.

3. If decidedly wet weather follows upon its introduction, even after an interval of several weeks, it is likely to start up and take visible effect; but continuous rains, depressing the vital energies of the insect, are commonly requisite to its efficient action.

4. It is always so generally prevalent, in a more or less latent state, among the chinch bugs of Illinois, both north and south, that it is very likely to appear and spread, as if spontaneously, whenever conditions favorable to its development long prevail, whether it has been purposely introduced or not.

5. The time elapsing between the establishment of such favorable conditions and the full development of the disease among the chinch bugs of any locality, may possibly be shortened if the infection has previously been introduced by any artificial means.

6. Whatever weakens the insect favors its spread, as a rule. It is consequently much more likely to attack adults than young, especially spent males and females which have laid their eggs, and which are soon to die of old age; but it nevertheless often kills young of all ages. In agreement with the above, we have noticed that the fall generation of adults is less subject to it, other things being equal, than the generation which matures in midsummer. As this fall brood is to live or winter before laying its eggs, it contains no worn-out adults.

7. We have lately ascertained that it may destroy the *eggs* of the chinch bug, and as these are commonly laid where they are kept more or less moist, this fact contains a suggestion of increased usefulness and a valuable hint as to the best time for introducing the infection into the field.

8. The fungus producing this disease will not *start* to grow on dead chinch bugs, if we may judge from the results of several experiments made this summer. Wherever a dead chinch bug shows its presence, consequently, it has made its attack on the living insect.

9. The resistant power of healthy chinch bugs exposed to infection is well shown by the fact that thousands of bugs, young and old, have commonly lived for many days, and even for several weeks, moulting, maturing, copulating, and laying their eggs, when shut up in infection boxes which had been heavily stocked with fungus spores from dead insects and had been made in every way as favorable as possible to the development of the disease. The percentage of those that would succumb from day to day was often ridiculously small.

10. The growth of the fungus in such boxes is sometimes checked and the whole experiment brought to a standstill by the appearance in the boxes of minute mites (apparently brought in with the food supplied to the bugs), which multiply in the boxes and greedily devour the fungus of white muscardine as fast as it grows.

11. Comparative experiments with fungus spores from diseased chinch bugs and with those derived from artificial cultures on corn meal moistened with beef broth, show that the latter are nearly, if not quite, as efficient agents of infection as the former. We have used only cultivated spores one or two removes from the growth on the insect, and consequently are not prepared to say that continued cultivation on an inanimate medium might not finally diminish the virulence of the fungus parasite ; but, on the other hand, we have no very good reason to suppose that this will prove to be the case. I have no doubt, however, that by a properly guarded procedure, these artificial cultures, which can easily be made in almost unlimited quantity, may be utilized for a dissemination of the spores of these insect diseases, with great advantage in convenience, expedition, and economy of operation.

From all our experimental work thus far completed, I draw the general conclusion that infection with the fungus of the white muscardine of the chinch bug is an uncertain measure, largely dependent for its practical value upon conditions beyond the influence of the experimenter, and whose occurrence or prevalence it is impossible for him to

foresee. It appears, on the other hand, to be so powerful an agency for the destruction of chinch bugs *en masse* when the weather favors its development and spread, and can be made by proper organization so inexpensive to the individual and the State, that it is well worthy of the most thoroughgoing scientific study and practical field experimentation.

PSYCHOLOGY.

The Burrowing Habits of Snakes.—In my snake enclosure I have kept a wooden box filled with loose cotton and crumpled paper, and having holes in its sides for the accommodation of the reptiles. Throughout the heated term the snakes spent a large part of their time in this box, but as the weather grew cooler they abandoned it and found new hiding places under their bath tub, or under loose boards, digging down as much as possible into the thin layer of earth which covered the floor of their enclosure. I then lined their box and covered it with cloth to make it warmer and they would occupy it in fine weather, but on stormy or frosty nights they would come out, crawl under it, and lie there torpid with cold.

It was evident that their instinct led them astray in this instance by prompting them to get as close to the ground as possible to avoid cold. One fine day when they were all in their box I took it out and put it down beside the garden walk, giving them their liberty that I might watch them seek their own winter quarters.

Some of the Eutæniæ burrowed beneath the mudsills of a shed and disappeared, while others found hiding places under the house and do not come out even on warm days. Of the water snakes, (*N. sipedon*), 7 in number, three have left me, but the others remain in the yard and have not yet found permanent homes for the winter. On fine days I see them darting about or basking in the sun beside a puddle which I have prepared for them. At night, or on cool days, they may be found coiled up under a water bucket or leaky rain barrel, but none of them re-enter their box. I have often been surprised at the amount of cold snakes of this species can endure.

One *Ophibolus getulus* searched about a little while and then crawled under an empty barrel beside the walk. A short time afterwards I tilted the barrel to see what he was doing and found that he was trying to make a burrow, but the ground was hard and it was slow work. Used to being watched he paid no attention to me but continued to scrape the ground with his rostral. When at length he had excavated a hole deep enough to hide his head he gave himself a rotary motion, turning half around then back again, boring the hole a little deeper and throwing out a little dirt with the projecting backs of his jaws. Sinking still deeper he would draw himself down, filling the hole tightly, and then drawing back a little would throw out fine dirt with

his scales and abdominal plates. At length he disappeared entirely, leaving a large handful of dry dirt on the surface and completely filling the burrow behind him with loose dirt. Another *O. getulus* burrowed out of sight in a garden bed, but the ground was loose and he did not throw back the dirt but seemed to press it aside, leaving his burrow open behind him.

I have seen the *Phyllophilophis æstivus* dig its burrows with its broad rostral, the *Heterodon platyrhinus* turn up the soil with its trihedral rostral with as much facility as a rooting pig, and have watched the *Carphophis amœna* working its way through loose ground like the earth worms on which it feeds, but the *O. getulus* digging in hard ground and throwing out the dirt behind it was an unexpected sight.—ANGUS GAINES.

Habits of Heterodon platyrhinus at Raleigh, N. C.—This snake which is quite common here, has a habit when interfered with of first flattening its head and body and violently hissing; more interference causes the snake to writhe about violently opening its jaws to the fullest extent, it then finally turns on its back and simulates death but still keeps its mouth wide open. After "dying" it becomes perfectly limp and may be carried in the hand a mile or more without showing signs of life, usually, however, still keeping the mouth open. One peculiarity alone shows life; if placed on the ground belly down, it at once turns on its back again nor can it be persuaded, however, "dead", to lie on its belly.

This snake, although perfectly well-known to every one here, seems to be frequently confounded with the copperhead; only two months ago a colored boy came to us to find a remedy for snake bite as he had been bitten (as his badly swollen hand attested) by a "Spreading Add."

Another snake also confounded with the Spreading Adder is *Natrix sipedon*, on account of the habit sometimes indulged in by the latter species, particularly by young specimens, of flattening the body in a manner similar to that of *Heterodon*.

The favorite food of *Heterodon platyrhinus* in this locality is the common toad, and they will sometimes take as many as three at a meal. If interfered with after a meal they frequently disgorge one or more toads. Personally I have never known them to eat anything else, but a friend who kept one for sometime said it would also eat young specimens of its own species.

The wholly black variety of this species is very rare here, so far I have only seen three specimens.—C. S. BRIMLEY.

ARCHEOLOGY AND ETHNOLOGY.[1]

Certain Sand Mounds of the St. John's River, Florida, by Clarence B. Moore.—The mounds of North America are documents which, to be read, must be destroyed, and the only excuse for their destroyer is that he has translated their meaning. If he has not —if he has not scrupulously recorded the depth and tint of each superposed layer and the position of each human trace, if he has not even gone farther and chronicled, for the sake of the future questioner, things that he sees no reason for chronicling, so much the worse for science. If, on the other hand, interested not in relics, but their meaning, he has carefully transcribed the facts observed he deserves the sincerest thanks of the student. These should be given to Mr. Clarence B. Moore, for his recent exploration of mounds and shell heaps in Florida. His book (Certain Sand Mounds of the St. John's River, Florida), is on the one hand an encouraging lesson to the investigator, while on the other it is a silent protest against much of the "relic hunting" that goes by the name of exploration. Each chapter condemns by inference, the treasure of the collecting enthusiast who, for the sake of his card boarded specimens, obliterates the pages of the book no less hopelessly than did Spanish priests when they threw Mayo Codices into the fire, and the value of specimens with a record, against the cheapness of those without one, increases as we read.

An account of 75 mounds of shell and sand faithfully explored by Mr. Moore on the St. John's River, Florida, catches the attention of the student at once, and he looks with particular interest for the result. What does it all mean? What have these painstaking labellings of specimens, fresh from the earth, these reiterated measurements, detailed minutiae, and laborious analyses, to tell us of the story of man? Are some explored sites older than others, so that we can prove a series of epochs in time? Do older sites yield a different class of remains from the younger, so that we may infer a sequence in culture, and suppose that the maker of mounds had a predecessor in Florida or, at least, developed there through a lower stage of culture into a higher? How long ago was it? Indians still live in Florida. Were these mound-makers' Indians? The white man came in the sixteenth century—which mounds were built before, which after, his coming? Which Indian arts were derived from him, and which preceeded his suggestion?

[1] This department is edited by H. C. Mercer, University of Pennsylvania.

Mr. Moore's results bearing upon some of these questions might be summed up thus:

(a) THE FLORIDA MOUNDS LIKE OTHER MOUNDS.

The Floridan builders of sand mounds and shell heaps were like other pre-Columbian mound building tribes known to archaeology. They had certain peculiar customs, such as nicking arrow-head outlines from pottery (Mulberry Mound and Tick Island) to bury with the dead, depositing great numbers of Fulgur shells in mounds (1307 from one trench in Mount Royal), and cutting out fragments of pottery with sharp instruments to inter in graves, but neither these facts nor the scattered charcoal and random hearths of the mounds, the catlinite, the cache of 53 arrow-heads (Mount Royal), the sheets of mica (Tick Island and Mt. Royal), the perforated mussel pearls, the stone tube (Bluffton) or the gouge (Mount Royal), could disconnect these tumuli from the life and habits of the Indian as the white man knows him. The mound-makers cached an extraordinary batch of little baked earthen shapes in Volusia Mound mimicking the bear, turtle, puma, wildcat, tapir, possibly; the bud of the water-lily, the acorn, gourd, and ear of maize, but there was nothing in the ornamented fragment of human skull (Bluffton), the sharpened fragment of human bone (Tick Island), the copper-sheeted animal jaw (Tick Island), the bits of Galena (Mt. Royal), or the copper (Mt. Royal) to set aside these structures as a class unique in themselves or apart from other mounds in the United States.

Like the Indians of Maine, the Floridians spread layers of hematite reddened sand near interred human bones (Mount Royal) or with deposited relics (Grant's Mound at Dunn's Creek). Some mounds, levelled to the ground, were empty, some contained only a few potsherds (St. John's Landing), and the irregular construction of many defied any practical theory of explanation. Sometimes relics were scattered broadcast about the mound, out of all relation to its shape, and not associated with any burial. There were cutting-tools of soft rock that use would have destroyed, "ceremonial" shapes of stone and pottery, caches of intractable and useless hornstone chips, and inexplicable arrangements of shells, betokening the doings of men who harkened habitually to the echoes of an invisible world, and, like Congo savages, drew half their life's inspiration from demonology and spirit worship. Here again, science is invited to explain the motive traits of humanity's childhood, and account for facts before it, not alone by the promptings of five senses, but by motives wild as the veering wind,

—motives to understand which is to half reveal the scheme of primitive existence, whose features, faintly suggested by archeology, elude the imagination. He best knows them who, searching deep, dares, like Mr. Cushing, the dreadful initiation of the Indian Priest.

When the mound-makers buried pots with the dead, they often knocked holes in them, not to render them worthless for grave robbers, since valuables often lay close by, but inferably for a religious reason. Sometimes they made the holes before the pottery was baked.

Like the Nanticokes, of Maryland, it appeared that they had dried the flesh of corpses off the bones, stored the latter in charnel houses, and, at given times, buried the store, for, though the interred skeletons found lay sometimes in anatomical order, as if they had been buried with the flesh on the bones, or before the ligaments had rotted, at other times (Duval's) the bones lay scattered in disorder or in bundles (Gunn's Grove), when, occasionally, the remains of one man (Orangedale) got mixed with those of another.

But, in all this, there was nothing extra Indian. Other mound-building tribes had been known to do all or most of these things, and we come to the second question—

(b) DIFFERENCE IN AGE OF THE SITES.

Following the rivers' course, there were two kinds of sites examined—sand mounds built deliberately by piling up loads of sand and earth on one spot, for burial or other pnrpose, and shell heaps (which, by the way, occur on the river only from its source half way down) made by people eating fresh water mollusks on one spot and throwing the shells under foot. At Tick Island, Bluffton, Thursby's, Thornhill Lake, Mulberry Mound, Gunn's Grove, Fort Taylor, and Raulerson's, the sand mounds were later than the shell heaps, for they were built directly upon the shell heaps. On the other hand, at Orange, the shell heap is later than the sand mound, for it rests upon the sand mound.

If we go by the comparative test of contents, some of the sand mounds and shell heaps must have been contemporaneous, as where, at Mulberry Mound, there were the same kind of tobacco pipes in the sand mound as in the shell heap. A few shell heaps contained plenty of pottery, though, as a general rule, they contained none, and we are left to infer that the art of pottery was unknown at their date, or, more reasonably, as I venture to suggest, (having examined several small sherdless shell heaps at York Harbour, Maine,) that some heaps may have been made entirely of *roasted* clams, where the cooking process (unlike boiling) required no pot. On the other hand, some sand

mounds contained no pottery, and none ever contained a certain kind of earthenware that seemed to have been tempered with small fibrous roots. This, when found at all, was found in the shell heaps. Professor W. H. Holmes, in an appended paper (The Earthenware of Florida), argues that this fibre tempered pottery may, nevertheless, be no older than the other sand mound wares, since often in form (identical with those of the best days of the art) and in design (the scroll pattern), it appears to be up to the finer models of the sand tumuli. Less still does he find characteristics in any of the other earthen specimens, whether from sand mounds or shell heaps and which he describes as paddle-stamped Cherokee fashion, extemporized by amateurs, often coiled, and never made in baskets or nets; chalky often, or gray coated and black within, to warrant the setting aside of any pattern of them all as older than the rest, or the use of any make as a test of age for the mounds or heaps.

Notwithstanding this and the fact that rarely the shell heaps (Persimmon Mound) were used like the sand mounds for burial, Mr. Moore thinks for the reasons aflove given, that the shell heaps, as a general rule, belong to an older time than the mounds.

(c) MOUNDS BEFORE AND AFTER WHITE CONTACT.

Though there can be no doubt that some of the tumuli were built before the coming of white men, there seems to be no reason for supposing that these mounds of Florida are any older than any other class of mounds or shell heaps in the United States. The mammoth's molar (Gunn's Grove) appears to have been picked up by a curiosity-loving Indian and used as a trinket. But there is nothing in the animal bones mentioned to suggest that the mound-maker was the contemporary of an extinct fauna, though the clay model of a tapir-like snouted animal (Volusia Mound) may mean that these people, like the Indians of Tennesee, saw the tapir.

Some of the mounds were built after the coming of the whites. There is no question about that, for glass beads and iron were found in the bases of them with disassociated bones, complete skeletons and bunched burials (Ranlerson's). There was a silver ornament and an iron axe at the bottom of Dunn's Creek Mound, and two skeletons were buried with flint-lock muskets and glass beads at Bayard's Point.

Some mounds, really pre-Columbian, and, in their original bedding, showing no white man's trace, had been notched on their sides and top with comparatively recent Indian graves containing European trinkets, and glass beads were found about the surface of some others (Volu-

sia, Thursby's, Gunn's Grove and Cook's Ferry). But many others again (Mount Royal, etc., etc.), which showed, from top to bottom, no trace of the white man, must, inferably, have been built before the coming of Europeans.

(d) MOUND COPPER NOT OF EUROPEAN ORIGIN.

To find an object of European make in a mound, is to date the mound after white contact, that is certain. But when we ask which objects were and which were not of European make or snggestion, and set aside a number of things easily in one category or the other, we soon come to the doubtful case of copper—copper which was mined by the Indians on Lake Superior to be pounded cold into trinkets; copper which the Spaniards found Indians casting in moulds in Mexico, and which, on the other hand, was traded to Indians by Europeans in the sixteenth century, to be again worked into trinkets. The copper in these mounds (Tick Island and Mount Royal), as in Ohio, (Hopewell's) appears in such smooth and extremely thin discs and plates, that, spite of its position at the mound's base, with no associated trace of Europe; spite of the aboriginal pattern, certain archaeologists would not believe it of American manufacture. Until Mr. F. H. Cushing succeeded in reproducing the specimens in cold hammered native copper, with Indian tools, the opinion held its own that the mound-makers had cut the shapes out of machine-rolled sheets brought from Europe. To settle this question, Mr. Moore has employed, at great pains and with great credit to his energy, the test of analysis.

That a component alloy should occur in European copper of the time in question, which never occurs in these mound specimens, and which likewise never occurs in the pure native material found in America, was a lucky chance. But such was proved, in a reasonable number of analyses, to be the case, and it settled the question. The tell-tale alloy is lead. The mound copper examined always had fewer impurities (sometimes only silver and iron) than the European, antimony and arsenic were from 19 to 45 times less abundant in mound copper than in European, but lead was *always* present in the European and never in the mound specimens analyzed.

It was only making assurance doubly sure to urge, after this, that the mound *designs* were aboriginal; that the objects of the same kind differed in size and shape, which, inferably, machine-made specimens would not do; that the Mount Royal breast-plate, though symmetrical, was not mechanically so; that the large plates were not originally made from single sheets, such as European mechanics would have fur-

nished, but from ragged-edged fragments rivetted together; and, finally, that the copper specimens were never found associated with objects of white man's make. But the main point had been already reasonably proved. The absence of lead had settled the question, and wherever the mound-building Floridans got their raw material, whether from the ancient diggings at Lake Superior, from Mexico, or from Cuba, where lead is equally absent in the native deposits, it never came from Europe.

H. C. MERCER.

MICROSCOPY.[1]

Formol as a Preserving Fluid.[2]—If the four atoms of hydrogen in the simple organic combination, swamp gas or methan, be replaced by a hydroxyl group there may be formed, one after the other, partly by the separation of water, (1) methylalcohol, (2) methylenglycol, (3) formic acid, and (4) carbon dioxide. The process may be illustrated in the following manner:

$$\begin{array}{c} H \\ | \\ H-C-H \\ | \\ H \end{array} = CH_4 = \text{methan.}$$

$$\begin{array}{c} OH \\ | \\ H-C-H \\ | \\ H \end{array} = CH_4O = \text{methylalcohol.}$$

$$\begin{array}{c} OH \\ | \\ H-C-OH \\ | \\ H \end{array} = CH_4O_2 = \text{methylenglycol; and } CH_4O_2-H_2O =$$

$CH_2O =$ formaldehyde.

$$\begin{array}{c} OH \\ | \\ H-C-OH \\ | \\ OH \end{array} = CH_7O_3\text{; and } CH_4O_3-H_2O = CH_2O_2 = \text{formic acid.}$$

$$\begin{array}{c} OH \\ | \\ OH-C-H \\ | \\ OH \end{array} = CH_4O_4\text{; and } CH_4O_4-2H_2O = CO_2 = \text{carbon dioxide.}$$

Of these five combinations it is formaldehyde that concerns us. It was discovered in 1863 by A. W. Hoffmann while passing wood spirit (methylalcohol) and air over a red hot platinum spiral. If the vapor

[1] Edited by C. O. Whitman, University of Chicago.

[2] The first half of this paper is a free translation of a paper by Prof. T. Blum in the Bericht. über d. senckenbergische naturf. Gesell. in Frankf. a. M., 1894, p. 195.—F. C. K.

is brought into water to its point of saturation, a 40 per cent solution of formaldehyde is obtained, which has long been known under the name of formol. The use of the termination "ol," here has been objected to as belonging especially to alcohols, but since we have to do not with the vapory formaldehyde of the discoverer, but with the hydrate, methylenglycol, an alcohol, this objection is not well founded. The first experiments as to the value of an aqueous solution of formaldehyde for the purposes of disinfection, hardening and preservation, were made with the solution under the name of formol; therefore, the general custom of priority giving the honor, I shall use the term formol.

Formol is a clear, slightly opalescent fluid with a sharp odor. By dilution of the fluid the odor is lessened and the liquid remains as clear as water.. It is best kept in glass vessels. In metal ones it often becomes of dark brown color and must then be allowed to stand quietly in a glass vessel before diluting for use. From the quiet liquid there settles a light cloudy precipitate leaving the liquid clear. A change of formaldehyde to an insoluable paraformaldehyde, that has here and there been noted, I have never met with.

After my son, Dr. F. Blum, made the discovery that formaldehyde posessed besides its known antiseptic action, the noteworthy property of hardening animal tissues without their shrinking and without altering their microscopic structure or staining properties, formol appeared to me to be the preservative fluid for which I had long sought. Without loss of time, I began my experiments upon animal and plant objects. These gave within the short space of a few months such encouraging results that I did not hesitate to publish them in a preliminary paper.[3] Since then the experiments have been continued at the Museum der Senckenbergischen naturforchenden Gesellschaft, and in different places others have likewise tested the preservative properties of the fluid.

Among my experiments those that follow are the most important. To begin with, several human embryos were placed according to age in formol diluted with 10 and with 20 parts of water and were finely preserved. Even a fœtus of 8 months in which the placenta and egg membranes were left intact, had taken up so much formol that it was hardened in spite of the resistance of the chorion to the diffusion of the liquid. The amniotic fluid was darkened, but the surrounding liquid remained clear. Somewhat finer results were obtained with smaller embryos. In one about 14 cm. long with uninjured amnion, this being thinner,

[3] Zoologischer Anzeiger, 1893, No. 434.

the amniotic fluid did not become turbid. Through it each structural particular of the embryo and navel cord is easily recognized. The temporal artery shows through the transparent skin as a dark brown streak, while beneath it is seen the brain through its capsule. In an embryo a little larger (30 cm.), the fine hair and hair follicles are finely preserved. This last embryo was in a 1:20 solution.

Experiments with a corpse have not been made, yet the possibility of one keeping, may be with safety assumed. In order not to be obliged to inject the fluid, it might be necessary to employ the stronger, at least 1:10 solution.

Of the Mammalia, mouse, hamster and porpoise have been left in a 1:10 solution for over three-fourths of a year. The fluid has not been changed and yet remains perfectly clear, while the animals are well hardened, unaltered in form and color, and with the hair firmly in place. The mammalian eye as well as that of other vertebrates keeps better in formol than in alcohol. Still after a time a turbidness appears —more in the lens than in the cornea.

Reptilia and Amphibia preserve well. Frogs, in consequence of the entrance of the fluid into the subdermal space, appear swollen, but in other respects are unchanged.

For fishes, formol especially recommends itself. The mucous and slime remain clearly transparent, never forming the white, stringy mass arising in alcoholic preparations. Most fishes retain their colors more or less completely. Gold fish, to be sure, loose their color in very weak solutions, and the red spots of the trout become white with time. A solution diluted 1:10, 1:20, or 1:30, according to the size of the animals may be used. In a short time the animals are very nicely hardened.

From a number of invertebrates I may mention that snails, especially slugs, show their form and colors through the transparent slime. Insects, spiders and Crustacea preserve at least as well in formol as in alcohol.

Living Hirudinea are contracted more in formol than in alcohol; at least the contracted specimens are numerous and the extended ones few. The straw-yellow colors disappear sooner, while, on the other hand, orange-yellow, green, brown and black remain unchanged.

Two jelly fish (*Aurelia aurita*) killed in a 1:20 solution and kept one in a 1:30, the other in a 1:50 solution, were hardened without an alteration of form, color, or transparency. That kept in the 1:30 solution is the better, but neither have been long in the fluid.

Single organs or pieces of muscle are quickly hardened in formol. It is notable, as pointed out by my son,[4] that the coloring matter of the blood is distinctly retained. The blood courses, it is true, fade and finally to all appearances disappear, but if the preparation be placed in alcohol of not too great a strength (60–90 per cent.)—the stronger the quicker the reaction—the characteristic blood color returns and there is obtained an excellent representation of the branching of the vessels. The change from formol to alcohol and *vice versa* may be repeated always the same results.

Brain hardened in formol gives very fine results.[5] Pieces and even the entire brain are hardened very quickly and show the white and gray matter sharply differentiated from one another. Sections are said to be much better than those of chromic acid preparations.

As has been mentioned, neither the microscopic structure nor the staining properties of tissues are destroyed by formol. Almost all the organs and staining methods have been tried. In the preparations, cell body and cell structure, as well as the nucleus caught both in the resting state and in process of division are fixed, while the blood corpuscles are sharply marked off from their surroundings.

Hens' eggs have been tried and have in many ways led to very interesting results. An unbroken fresh egg in a 1:15 solution showed, after 8 days, the white forming about the yolk a mantle of an outer fluid and an inner slimy consistance. The yolk was hard, remaining fluid only in the middle. The hardening process here then is the reverse of that of cooking. On the day following, the yolk had become much harder, while the white was changed only after a long time and never neared the hardness of the yolk. Upon opening an egg after 38 days a faint odor of formol was perceived. The yolk was hard, sectionable, and showed an outer zone of 1½ mm. breadth and an inner beautiful yellow mass. The yolk was surrounded by a grayish, scarcely sectionable, gelatinous mantle in which the chalazea and germinal-spot were plainly visible. About the mantle was a very slightly opalescent albuminous fluid.

A fresh egg with a small hole in it showed under like conditions the same phenomena, but within a shorter time, or about 17 days. After 68 days such an egg was noticeably harder. The firm white clung to

[4] Anatomischer Anzeiger, Vol. ix, No. 7.

[5] See Born, "Demonstration einer Anzahl in Formaldehyde (Formol) gehärteter menschlicher Gehirne." Mediz. Sektion d. schlesisch. Gesell. f. vaterl. Kultur., 1894.

the shell so that it shelled like a cooked egg. The white had the appearance of gelatin, was firm, and whitish-gray. The yolk was very hard and breakable.

Similar results to those with the unbroken eggs were obtained with uninjured eggs in formol vapor (a very few drops).

A cooked egg kept in formol vapor after 30 days appeared as fresh as though newly cooked, smelled of formol on the inside and had a sharp taste.

A fresh, unbroken egg that had been for 75 days in a 1:5 solution of formol was placed for 15 minutes in boiling water. Both yolk and white had the same appearance as in an uncooked egg that had been for a similar length of time in formol. In spite of the long cooking the white had not taken on that beautiful porcelain white appearance common to cooked eggs, and had not changed its firm gellatinous condition. Hence through the action of formol the white of an egg looses the property of coagulating by heat. If, as now assumed, egg-white bodies are those substances that are changed in chemical constitution by the action of formol, then the difference in the action upon the white and the yolk of the hen's egg offers a most worthy test for the study of different albuminous substances.

Experiments with plants were made in considerable number. In general the preservative action of formol upon the colors of flowers is less than the first experiments had led me to hope. Nevertheless, this means of preservation is a step in advance. Many flowers placed in formol during the summer were usable as demonstration preparations during the following winter. A passion flower in a 1:20 solution after nearly ten months, is still a beautiful preparation. Further, many composites, viz., such as had a yellow color, like *Helianthus argyrophyllum*, *Calendula officinalis*, etc., have been well preserved. Also a rhododendron flower (in 1:20), a rose (in 1:50), *Akebia quinata* (1:20), *Cornus mas* (1:20) and so on, have been changed in form and color but little. Fragant flowers and fruits turn the formol to an agreeably odiferous fluid. Chloropyll is not drawn out by the fluid, but the green color of tender leaves become pale with time. A *Dieffenbachia* with a bulb grown upon the spathe is almost faded, but forms never the less a fine preparation. Firm leaves like those of *Rhododendron* are altered but little. Fruits are well preserved. Blue grapes, currants, medlars, several species of *Cratægus*, *Cephalotaxus*, banana, different species of *Solanum*, *Magnolia tripetala*, strawberries, and *Mangifera indica*, that have been in formol ever since the fall of 1893, are nicely preserved. In a very few fruits the action of the preservative is injurious.

The use of a very dilute solution of formol works badly for the reason that from such a fluid the water is absorbed very decidedly. At least fruits became swollen more often than plants in the dilute solutions. Cherries, for instance, keep well in a 1:30 solution, but in one of 1:60 or 1:80 they burst open. The entrance of the fluid into the colored envelopes of flowers is also very noticeable. How dilute the solution may be for the different plants is difficult to say. It must be determined by experiment.

Of Cryptogamous plants I have till now experimented only with truffles (1:10) and young *Phallus impudicus* (1:30). This last was cut in two and forms an excellent preparation.

Cohn declares that formaldehyde forms an excellent means of preserving *Leuconostoc* and chromogenous bacteria since the jelly and color are not changed.[6]

The value of the fluid for preserving bacteria has been noticed by Hauser.[7] He shows that gelatin in which micro-organisms are grown is changed by formaldehyde vapor so that it will not become fluid, and that gelatin already peptonized becomes hard again in the vapor. Neither the gelatin nor the micro-organisms suffer a noticeable change, and the preparations can be kept for demonstration or museum purposes.

In microscopic sections of plants that have been in the preservative (1:20) for several months the cell wall, protoplasm and chlorophyll bodies appear as in fresh specimens.

I have not yet undertaken to determine the freezing point of the formol solution, but will remark that during the past cold winter in an unheated store room the diluted solution was not frozen, and that even in the open air at a temperature of—18° C the concentrated solution remained fluid.

In conclusion the properties of formol as a preservative medium may be summed up as follows:

Animal objects are hardened with shrinking, and without losing their microscopic structure or staining properties.

The natural form and color is preserved.

The eye remains much clearer than in alcohol.

The mucous of slime producing animals is not coagulated and remains transparent.

The coloring matter of blood in tissues apparently disappears, but may be quickly restored by a high per cent alcohol.

[6] Bot. Centralbl., Vol. lvii, No. 1, 1894.

[7] Münchener med. Wochenschrift, 1893, Nos. 30 & 35.

Plant structures are more or less well preserved; most fruits keep well.

Chlorophyll is not extracted, but after a long action of the fluid delicate leaves may be changed. The duration of the retention of other coloring matters is different with individual plants.

Microscopic sections of plants that have been a long time in formol give fine preparations.

Dilute formol is not combustible and is much cheaper than alcohol.

To the above experiments described by Blum may be added those of Dr. Th. Pintner, Dr. C. Krückmann, and a few notes of my own.

Dr. Pintner used a 1 per cent. solution of formaldehyde in sea water for Discomedusæ, *Æquorea* and *Aurelia* without their form being affected.[8] The same solution was used with sponges such as *Suberites dominicula* and *massa*, *Clathria coralloides*, *Aplysina aërophobia*, etc., with equally good results. But animals that contract much in killing must first be treated with Lo Bianco's Naples methods, and then transferred to the solution of formaldehyde. He found that all animals do not retain their color, as for instance, the red coloring matter of actinia and of *Comatula* is extracted.

Dr. Krückmann working with bacteria used stronger solutions and obtained the best results by combining corrosive sublimate with formalin.[9] To begin with, a formalin solution of moderate strength was used and this gradually increased until the specimens were in pure formalin. Bacterial cultures were fixed by placing them in an excicator containing formalin instead of sulphuric acid, and in order to tan the surface of the medium, it was covered with a 1:10 solution of formalin containing 1 per cent of sublimate. This was later changed to a stronger solution of formalin and the tube hermetically sealed. By following this process he found that colors were much better preserved and the more or less inevitable crumpling very much diminished. The solution worked well with all media except potato.

The few experiments that have been performed by myself seem to indicate that too weak solutions of formalin have hitherto been used except in the bacterial experiments of Krückmann. The material used was what came nearest to hand, and consisted of a tree-frog, salamanders, earth worms, sow-bugs, myriapods, plant-lice, slugs, cat liver and blood, blood of salamander, nostoc and a pond scum. The solutions used varied from 1 per cent. to pure formalin. Two species of

[8] Ver. zool.-bot. Ges. Wien, xliv, (1894), p. 8.

[9] Centralbl. f. Bakteriol. u. Parasiteuk., xv, (1894), pp. 851–7.

Plethodon placed in a 4 per cent. solution of formaldehyde (=10 per cent. of the commercial formalin) were soon killed, and on the day following the immersion were thoroughly hardened and after a week or so have not shrunken noticeably further than that the costal furrows are a little more strongly marked than in life. The reddish coloring of one of them is fully as fresh as when the animal was caught. A tree-frog placed in the same solution at the same time became somewhat swollen, but by cutting the skin in the abdominal region, the swelling was then shown to be due to an entrance of the fluid into the subdermal space as pointed out by Blum. The swollen tongue, which protruded from the mouth a little, would indicate, however, that there had been a swelling of some of the tissues. The same swelling of the head was noticed in the salamanders, but with them it is not so marked.

A single adult *Amblystoma punctatum*, that had been first anesthetized with chloroform, was placed in a solution equivalent to about 1 per cent. of formaldehyde, and was found to harden rapidly. There was, however, a very noticeable swelling of the whole body within twenty-four hours, while, at the same time, the costal furrows, as in the *Plethodon* specimens, became more marked. After about a week's immersion in the 1 per cent. solution, it was found that the bright orange-yellow spots of the live animal had very noticeably faded to light yellow. The specimen was then changed to a 4 per cent. solution and after an equal length of time the fading appeared to have gone no further, while the swelling was somewhat reduced. As it is the specimen is much better preserved than it would have been in alcohol.

Earthworms and the Arthropods were tried in all solutions. The former swell but slightly in the weaker solutions and contract very much less in the stronger ones than they would in alcohol, chromic acid or the other hardening agents. They harden in a ¼ per cent. solution as well as in the stronger ones or in pure formalin, the difference being one of time. In the Arthropods—sow-bugs and myriapods—the fluid in some of the experiments entered the body to such an extent as to stretch the animals out, leaving broad gaps between the harder parts of the segments. This stretching or swelling was first seen in the specimens in the 1 and 2 per cent. solutions, but sometime later those in all the solutions below 1 per cent. were fully as badly swollen, if not more so. Besides this the brownish colors of the animals became more faint, while the fluid became very much colored. This extraction of color is most noticeable with the ¼ per cent. solution.

Slugs placed in ¼, ½, ¾, 1, 2, 4, 8, 10 and 20 per cent. solutions seem equally well preserved. In the 1 and 2 per cent. solutions the head is

a little more distended than in the others. When first placed in the solution they gave off considerable slime, but this became perfectly transparent so, as noted by Blum, the form and colors of the animals were not obscured.

With salamander blood some startling effects were obtained. A few drops of blood were placed on a slide in a 1 per cent. solution of formaldehyde and watched under the microscope. The corpuscles and especially the nuclei were seen to swell rapidly. The nuclei became as large almost as the original corpuscles and were seen to pop out of the corpuscle like a grape from its skin. The envelopes then became very pale and finally disappeared from view, the nuclei, however, remained very distinct. Staining with Erlich-Biondi mixture showed that the body of the corpuscles had simply been rendered very transparent by the solution, while immersion in alcohol coagulated the fibrin into an opaque, straw-yellow mass, and brought the corpuscles faintly back into view. This explains the phenomenon of the return of the color of blood vessels noted by Blum as due to the coagulation of the fibrin which may also be stained somewhat by the color drawn from the corpuscles. The same experiment was performed with a 4 per cent. formaldehyde solution in place of the weaker one and the swelling effect found to be very much lessened, none of the nuclei becoming as large as the corpuscle nor escaping, otherwise the results were the same.

After this an earthworm was anesthetized with chloroform, placed in a 1 per cent solution of formaldehyde for several hours and afterwards removed to a 2 per cent. solution. There it remained for an equal length of time, when it seemed perfectly hardened and was removed to Czoker's alum cochineal. On the following day pieces were rapidly dehydrated in 70 per cent. and 95 per cent. alcohol and imbedded in paraffin. Sections made from them showed all micro-anatomical details perfectly preserved. Nothing had stained but the nuclei which had all become very much swollen, giving the whole section a bright red-purple appearance. So decidedly had they swollen that in both series of the muscular system, and in the septa where they are not ordinarily visible, nuclei were shown very distinctly and in large numbers. Careful observation showed the nucleolus a little more deeply colored than the rest, while the chromatic filaments seemed swollen and less distinct.

Sections were also made of an earthworm hardened in pure formalin and no swelling whatever was to be noticed, while all cytological detail was remarkably well preserved.

To counteract the swelling effect of the weak solutions alcohol was employed. A 5 per cent. solution of formaldehyde in 50 per cent. alcohol hardened pieces of earthworm and cat liver very rapidly, so that on the day following their immersion, sections could be obtained by the paraffin method. Here the nuclei were found not to have swollen noticeably, if at all, while nuclear detail was plainly brought out by staining. In the pieces as a whole, there was neither swelling nor shrinkage, while the liver did not become as pale as it would have in alcohol.

For stains alum cochineal, Erlich-Biondi, Orth's picro-carminate of lithium, Erlich's acid hæmatoxylin, picric acid, fuchsin and saffranin were tried and their action found not to be very much if at all interferred with by the formaldehyde. In one instance a piece of an earthworm was placed in equal parts of 2 per cent. formaldehyde and alum cochineal. On the following day it had been little more than superficially reddened, while a piece that had been removed from the same solution (2 per cent.) of formaldehyde and left for the same length of time in undiluted alum cochineal had stained perfectly.

In *Nostoc* the dark yellowish-green has been extracted in 4 per cent formaldehyde leaving the filaments as seen with the naked eye of a whitish or very light green, while a dark green pond scum after immersion in the fluid for nearly two weeks has changed slightly to brownish-green. Still it is not unlike old specimens of the same and similar material that one often finds in ponds.

In conclusion it may be said that for general purposes, solutions of at least more than 2 per cent. must be used in order to avoid the swelling and decolorization of specimens, that from 4–8 per cent. will give the best results. For histological purposes formalin combined with alcohol will give better results than either used alone; while the weak (1–2 per cent.) solutions by swelling nuclei may serve the very important special purpose of demonstrating the presence of cells not otherwise readily distinguished.

F. C. Kenyon.

SCIENTIFIC NEWS.

Bibliographical Reform.—The pressing need of an improvement in the methods of indexing scientific literature is admitted on all sides. Especially a young and growing science like zoology feels this want.

Present bibliographical aids are inadequate in three principal re-respects: First, they are incomplete; second, they are tardy in furnishing notices of papers; and third, they do not enable one to find quickly all references to any subject of which one desires the literature.

Although at various times attention has been called to the exisiting imperfections in our bibliographical service, it is only lately that active steps have been taken to improve that service radically.

Over a year ago Dr. H. H. Field began to agitate the matter of reform in the bibliography of zoological literature by a letter, printed in Nature (Vol. xlvii, p. 607, Apr. 27, 1893). Last spring the Royal Society of London, whose Catalogue of Scientific Periodicals is well known, sent a circular to scientific men and institutions asking for suggestions concerning the compilation through international coöperation, beginning with the year 1900, of a complete catalogue of scientific literature, giving not only titles arranged according to authors's names, but also an index to subject matter. This request has already excited earnest attention and seems certain to elicit a cordial response.

Dr. Field's plan in no wise conflicts with the Royal Society's purpose; it may, indeed, be said to coöperate in it. He believes that the reform on the zoological side ought not and need not wait half a decade. It should begin at once. If the plan proposed by Field should be successful it would show the probability of success of the larger undertaking mentioned in the Royal Society's circular. If that undertaking should be begun in 1900 the zoological part of the work, already organized would be easily absorbed by it.

Field has already drawn up the outlines of a definite plan after consultation with prominent zoological bibliographers in Europe. These he has already published. Besides the printed letter in Nature, referred to above, a statement of his plan can be found in the Biologisches Centralblatt, Bd. xiv, pp. 269–272; Verhandl. Deutschen Zool. Gesell. iv Jahresversammlung, 1894; and Mém. Soc. Zoologique de France, Tome vii, pp. 259–263.

The essential points of his plan are these: First a single international bureau, situated at some great library centre in Europe, which shall receive all zoological papers. It shall make such arrangements as are necessary with governments, publishers and directors of zoological institutions for obtaining all zoological publications, and it shall have agents in every country or province to see that the literature of that region is sent to the bureau.

This bureau will obtain synopses of the contents of all papers and books, through authors, publishers and paid agents. The central bureau will, moreover, superintend the printing and distribution of its publications.

This bureau will also naturally acquire, in time, an invaluable collection of the entire zoological literature from the time of its foundation.

Second, publications in two forms: 1st, a pamphlet of titles and books with short synopses, resembling, but somewhat more extended than the various more or less incomplete bibliographical lists now published in different periodicals. This pamphlet to be issued at brief intervals. 2nd., the same titles including synopsis printed either on one side of a narrow sheet or on separate cards of standard size. The synopses to give a clue to the contents of the papers and to serve as a basis for the arrangement of the cards according to subjects. At suitable intervals a subject index to the literature, based on these synopses to be published.

Field had the intention of submitting his plan to the American Society of Naturalists at their New Haven meeting, last year, in order that they might be the first to appoint a committees to confer with similar foreign committees in the further elaboration and the inauguration of the undertaking. He believed that, owing to the friendly relations existing between this country and all European nations, America could best take the initiative in this work. Owing to an unfortunate delay in the mails, however, Field's paper, presenting the subject, came too late for presentation to the American Society.

Since that time Field has submitted his plan to the zoological Societies of Germany, France, and Russia and these have appointed committees to act together in considering the details of the plan and methods of supporting it. Besides the recognition by societies, numerous individual zoologists of Germany, France, Russia and England—among them v. Bardeleben, Bouvier, Dohrn, Hoyer, Paul Mayer, Minchin, Mitrophanow, and Schimkewitsch—have signified their interest in the plan and many of these their willingness to coöperate.]

Although American zoologists cannot be the first to make a definite move in the direction of bibliographical reform their hearty coöperation at the present critical time will help to make it an accomplished fact.

Besides coöperating with the committees from other countries, American zoologists can contribute to the success of the plan in two ways. They can see that copies of their own and others' publications are forwarded to the central bureau and they can make synopses of their own papers and others dealing with their specialities. Those who are willing to aid in these directions should communicate with Dr. H. H. Field, 67 rue de Buffon, Paris, France.

An Academy of Sciences for Michigan.—At a meeting of about 25 persons, held in Ann Arbor, June 27, 1894, it was unanimously agreed that it was desirable to form a society for the purpose of scientific research in the State of Michigan.

At this meeting, the officers whose names are appended were elected to serve until a permanent organization should be effected, and were instructed to act as an advisory board with the duty of recommending a constitution and by-laws for adoption by the society, and of preparing a program for the next meeting.

At a meeting of the advisory board it was unamiously agreed to recommend that the name of the society be the "Michigan Academy of Sciences," and that it have for its principal object the study of the agriculture, archeology, botany, geography, geology, mineral resources, zoology. etc., etc., of the State of Michigan, and the diffusion of the knowledge thus gained among them. It is not the opinion of the advisory board, however, that the work of the society should be restricted to the subjects named but should be enlarged from time to time as occasion may require.

W. J. Beal, President, Agri. College; J. B. Steere, Vice-President, Ann Arbor; F. C. Newcomb, Secretary, Ann Arbor; W. B. Barrows, Agr. College; I. C. Russel, Ann Arbor.

The Journal of the Biological Association of the United Kingdom (Vol. iii, No. 3, 1894) contains, besides special articles noticed elsewhere, the report of the director, from which we learn that 12 persons occupied tables during the year 1893–4, and that 9 articles were published as results of work done there. The expenses of the year amounted to about $11,000. We regret to see that the regular receipts are not sufficient to meet the outlay. An interesting fact is that over $350 was received from entrances to the aquarium room.

Dr. H. Solereder has been appointed custodian of the botanical collections at Munich.

Dr. Zimmermann has been made professor extraordinarius of botany at Tübingen.

Dr. Filhol is the professor of comparative anatomy at the Museum of Natural History at Paris, succeeding Pouchet.

Dr. A. Oppel has been appointed extraordinarius in embryology and microscopy at Freiburg, i. B.

Dr. E. Stolley has been appointed docent in Geology at Kiel.

Major C. L. Griesbach, for twenty years connected with the survey, has been appointed director of the Geological Survey of India.

A new biological journal has appeared in Germany, the "Archiv für Entwichlungsmechanik" edited by Prof. Wilhelm Roux of Innsbruck and issued by the house of Engelmann in Leipzig. The first number contains the following papers. Roux, Cytotropismus of the blastomeres of *Rana fusca*; Ribbert, compensational hypertrophy and regeneration; Barfurth, experimental regeneration of superfluous limbs in Amphibia; Barfurth, are the limbs of frogs capable of regeneration? Tournier, origin of joint forms. The first number is illustrated by 7 plates and costs 10 marks. Each volume will contain about 650 pages.

An appreciative sketch of the late Dr. H. A. Hagen by Samuel Henshaw appears in vol. xxix of the Proceedings of the American Academy of Arts and Sciences.

Dr. Altmann has been made professor extraordinarius of Botany at Freiburg iB.

Dr. Ed. Holzapfel has been appointed professor of Geology and Paleontology in the technical school at Aix la Chapelle.

Dr. Rudolf Burckhardt, formerly of Berlin, is now extraordinary professor of comparative anatomy at Basel.

Dr. Erich Haase, the well-known student of myriapods, died in Siam, in the last of May.

Prof. J. Jägge, director of the botanical museum at Zürich, died June 21, 1894.

Dr. O. Th. Sandahl, the physiologist, died at Stockholm, June 22.

Dr. Paul Albrecht, of Hamburg, is dead.

Dr. Carl von Heider, formerly of Berlin, has been called as ordinary professor of zoology, and Dr. M. von Lenhossek of Würzburg as professor of anatomy, at Innsbruch.

Dr. R. von Lendenfeld becomes ordinary professor of zoology in Czernowitz.

Dr. Schewiakoff of Heidelberg goes as assistant in the Zoological Institute of St. Petersburg.

A. C. Gill has been appointed assistant professor of mineralogy and petrology at Cornell University, and Gilbert D. Harris assistant professor of Paleontology at the same institution.

Miss L. C. Deane has been appointed instructor in biology at Vassar College.

At Wellesley College the following appointments have been made: Edith J. Claypole and Miss Hubbard, instructors in physiology; Elizabeth F. Fisher, instructor in geology and mineralogy.

Charles S. Prosser, formerly instructor at Cornell University, has been called to the chair of geology in Union College.

Dr. W. S. Nickerson is occupying (ad interim) the chair of biology and histology in the University of Colorado at Boulder.

Recent Deaths.—Prof. Paul Albrecht, vertebrate anatomist, of Hamburg, Sept. 15, 1894. Dr. C. M. von Bauernfeind, Director of the Technical School of Munich, August 2, 1894. Prof. Friedrich Bidder, physiologist, of Dorpat, August 31, 1894, aged 84 years. G. Cotteau, student of Echinoderms, of Auxiere, at Paris, August 10, 1894. Prof. A. Hannover, anatomist, at Copenhagen, July 8, 1894, aged 80. Salomon Herzenstein, Conservator of the Zoological Museum of St. Petersburg, ichthyologist, August 19, 1894, aged 40. A. F. Kuwert, coleopterist, at Wernsdorf in Prussia, August 15, 1894. Prof. Michele Lessona, zoologist, at Turin, July 20, 1894, aged 71. F. E. Mallard, mineralogist and crystallographer, at Paris, July 6, 1894. Prof. Natanael Pringsheim, the well-known botanist, at Berlin, October 6, 1894, aged 70. Baron Gerhard-Maydell-Stenhusen, botanist and Siberian explorer, at Bad Ems, August 18, 1894. W. Topley, geologist, at London, Sept. 30, 1894, aged 53.

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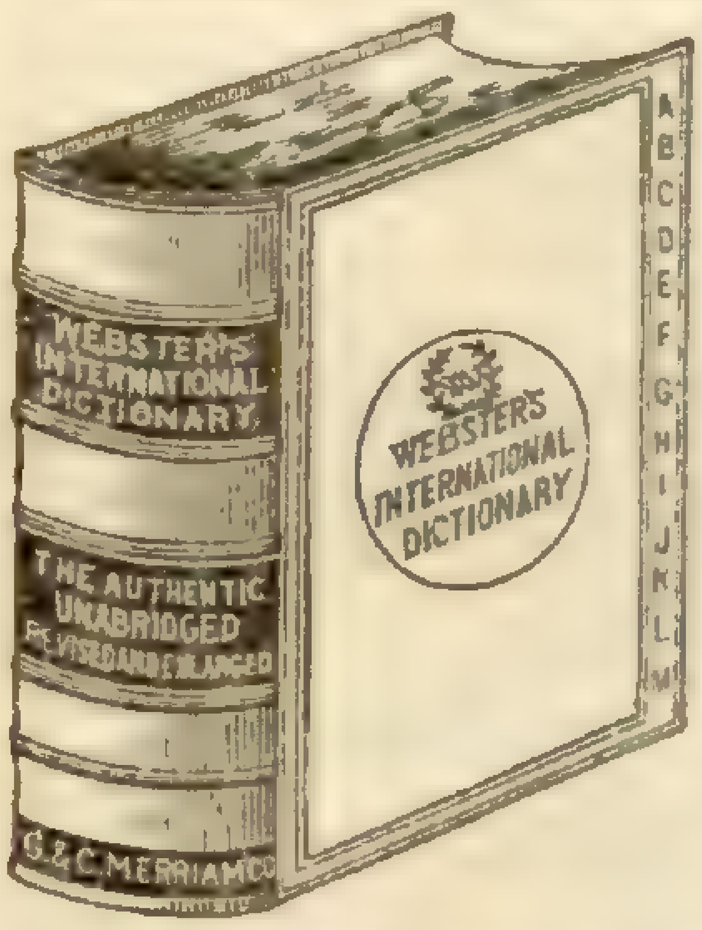

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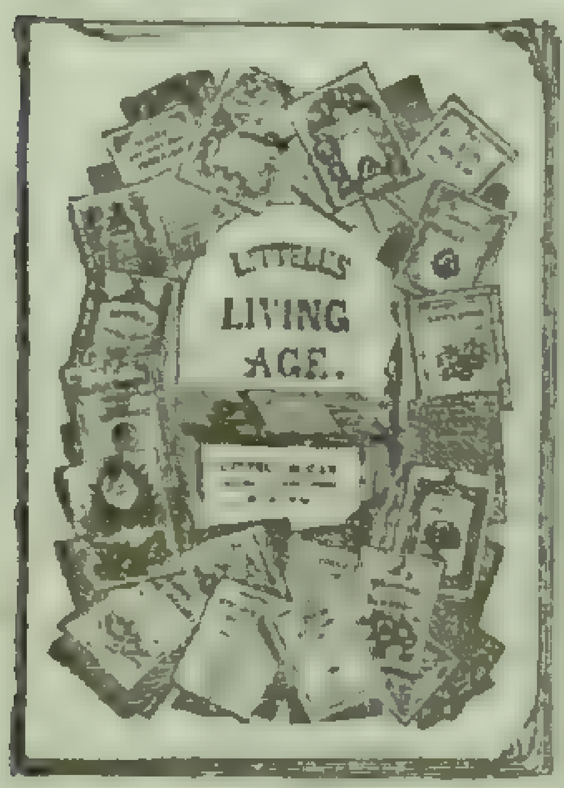

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Vol. XXIX. FEBRUARY, 1895. No. 338

CONTENTS.

PAGE.

THE PHILOSOPHY OF FLOWER SEASONS, AND THE PHAENOLOGICAL RELATIONS OF THE ENTOMOPHILOUS FLORA AND THE ANTHOPHILOUS INSECT FAUNA. (Illustrated.) *Charles Robertson.* 97

INSANITY IN ROYAL FAMILIES. A STUDY IN HEREDITY. *Alice Bodington.* 118

THE SIGNIFICANCE OF ANOMALIES. *Thomas Dwight, M. D., LL. D.* 130

EDITOR'S TABLE. 136

RECENT LITERATURE—The Mesozoic Echinodermata of the United States—Tertiary Rhynchophorous Coleoptera of the United States—The Fishes of Pennsylvania. 138

RECENT BOOKS AND PAMPHLETS. 140

GENERAL NOTES.

Geography and Travels—An Expedition to Labrador. 143

Mineralogy — Minerals from the Chromite Deposits of Lower Silicia—Artificial Reproduction of Anhydrite from Evaporation of Salt Solutions—Artificial Crystals of Zinc Oxide—Artificial Copper Crystals in Aventurine Glass—New Minerals. 148

Petrography—Geology of Angel Island, San Francisco Bay—A New Rock-Volcanite—Acmite Trachytes from Montana—Petrographical Notes—New Books. 152

PAGE.

Geology—Meunier on Meteorites—The Origin of Bitumens—Changes in Ore Deposits—Dean on Coprolites—New Molluscan Forms from the Dakota Formation—Glacial Lakes in Western New York—Geological News, General — Archean—Paleozoic— Mesozoic — Cenozoic. 157

Botany—The Systematic Botany of North America—Botanical News. 164

Zoology—The Influence of changed Environment on Mollusca—The genus Leptophidium—The Habitat of the Salamander Linguelapsus annulatus—The White Headed Eagle in Northern Ohio—The Paludicolæ—Mexican Glires—Zoological News. Spongiæ—Pisces—Reptilia—Aves—Mammalia. 167

Entomology—Two New Species of Lecanium from Brazil—The Wood Leopard Moth (Illustrated.)—Relaxing Insects—Eyes of Phalangiidæ—Spread of Otiorhynchus ovatus. . . . 174

Embryology—Development of an Isopod. . 180

Archeology and Ethnology—Discovery of Shell Mounds in Chira Valley, Peru—The Neanderthal Man in Java. 188

Microscopy—On a New Method of Entrapping, Killing, Embedding and Orienting Infusoria and other very small Objects for the Microtome (Illustrated.) 194

PROCEEDINGS OF SCIENTIFIC SOCIETIES. . . . 199

SCIENTIFIC NEWS. 210

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THE PHILOSOPHY OF FLOWER SEASONS, AND THE PHAENOLOGICAL RELATIONS OF THE ENTOMOPHILOUS FLORA AND THE ANTHOPHILOUS INSECT FAUNA.

By Charles Robertson.

The writer's determination to discuss the subject of flower seasons at the present time is owing to the publication, by Mr. Henry L. Clarke, of an interesting and suggestive paper on the same topic in the Naturalist for September, 1893. Having been engaged since 1886 in the investigation of the mutual relations of flowers and insects, he has been led in a very natural way to consider the time of blooming of flowers adapted to insects and the time of flight of the insects which depend more or less upon a floral diet. In 1890 a tabulation of both groups was begun, based upon the data then at hand, and since that time the author has had lying before him lines indicating the periods of the separate species and curves indicating the periods of the families of entomophilous plants and of the genera of bees, and the families of the principal remaining anthophilous insects; all, however, in the process of being modified by the accumulation of data. As a result, certain views have been arrived at regarding the relations of the

periods of particular flowers to particular species of insects, of families of plants to certain groups of insects, and the relative positions of different groups. Under these circumstances, Mr. Clarke's paper was read with particular interest, though it has not seemed to justify an abandonment of theoretical conclusions previously held.

The factors admitted by Mr. Clarke to have an influence in determining the blooming time of flowers are as follows:

1. "The blooming period may sometimes vary from the general rule to better bring the flowers among the most favorable conditions for cross-fertilization."

2. "Again, plants that are frontiersmen from the characteristic vegetation of a hotter clime may be expected in the hottest of the seasons—*e. g.*, the Cactaceae."

3. "There is an evident limitation of the flowering of our trees and shrubs to spring and earliest summer." "The blossoming of so many trees, especially the Diclinae, in earliest spring, before leaf-budding, must evidently have at least partial connection with anemophilous cross-fertilization."

4. "Again, there is a determining function in the character of the flower's habitat—the spring flowers seek largely the protection of the woodlands; marsh plants reach perfection mainly in latest spring and through the summer, though some, like Caltha, are early; the aquatics of ponds and river glory in the summer sun; and the flowers of meadow and prairie and thicket margin luxuriate from midsummer to the end of autumn."

But the principal deductions of Mr. Clarke are these: "*From early spring to late autumn there is a progression in the general character of the flower groups, from the lower to the higher—successive groups succeeding each other in time, parallel groups coming synchronously.* And the later in order may be *types* of a higher character of development, or they may be *specializations* of a group whose *normal* forms belonged to an earlier season. In their blooming season, *the more perfect succeed the more simple*; *the aberrant, the normal; the specialized, the g ralized.*"

In the solution of the problem of the flower seasons of a given flora I think that the period of no plant should enter as a factor, if it is so far removed geographically that at its blooming time it does not become a competitor of any plant of that flora. Any number of flowers adapted to the same conditions may bloom at the same time if they are so widely separated that they do not interfere with one another, but it would be an obvious disadvantage for very many of them to bloom at the same time in the same locality. In the latter case a separation of the blooming times would be advantageous. On the other hand, there are some objections to the use of data derived from a local flora, though I think they are not so serious. Phenomena which seem to find an explanation in a limited field may in fact find their true explanation in conditions outside of that field. Even in the case of a local flora the time of blooming is likely to be indicated as too long, since it is based upon the early dates of early seasons, and the late dates of late ones. Such data give rise to error by making it appear that the period of an early species overlaps with that of a later one when in fact the two species never have flowers in bloom at the same time in any season. It is hardly practicable to avoid this, since observations confined to a single season are liable to be too fragmentary.

To note that a given family of plants is highly specialized and that it agrees with Mr. Clarke's generalization by reaching its maximum in summer, does not help one to understand either the general position of the family or the blooming time of a single species, and the difficulty remains the same whether the species blooms before or after the bulk of the family, or whether its season coincides with the maximum. The main fault that may be found with his elucidation of the subject is that it is implied that the general principle of the late blooming of highly specialized flowers is an explanation of the blooming phenomena; for, whenever a flower agrees with the generalization, it is left as if it were thus explained, while, if it is an exception, its period is accounted for under the considerations which we have numbered. And it must have been a striking fact to the readers of the paper that the exceptions yielded so

readily to these considerations that they remained the only cases which were clearly elucidated. But it is hardly fair to dwell too strongly upon this point, for towards the close of the article, Mr. Clarke has expressly said: "Here the question rises, why should there be a correspondence between the course of the flower seasons and the system of floral evolution? Solve this and the 'Philosophy of flower seasons' is an open riddle." Stated in this way, as a very interesting and important fact to be explained, I see little in the paper to which objection can be made. Otherwise, it might not unfairly be considered as an attempted refutation of the Darwinian flower theory, for what becomes of that theory if it can be shown that the time of blooming of insect-pollinated flowers is not correlated with the time of flight of flower-loving insects?

The object of this paper will be to attempt a preliminary contribution to the subject from the standpoint of data derived from the *indigenous* local flora near Carlinville, Illinois (lat. 39° 21′), to test Mr. Clarke's main proposition, to undertake to account for flower seasons as a result of the competition of plants for the services of various pollinating agencies, and those of insect-loving flowers as also correlated with the flight of flower-loving insects, and to attempt an explanation of the fact of the general preponderance of the most highly specialized flowers in late summer.

When a plant in a plastic condition succeeds in establishing itself in a highly favorable position, it throws off a number of closely allied forms which finally become more or less well marked incipient species. As a result we find a number of nearly related forms in competition for a similar position in the soil, for a favorable position in the sunlight, and for the aid of the same pollinating agency. The process of producing similar forms may go on until the competition becomes so severe that it becomes disadvantageous. Then it becomes advantageous for some of the forms to avoid competition[1] with the dominant group by migrating to a different region, or to a different kind

[1] In the interaction of organisms in the struggle for existence it strikes me that a law of avoidance of competition is more obvious than that of the survival of the fittest.

of soil, to modify their floral characters so as to attract a different set of visitors, or to separate their times of blooming so that they may not have to compete with a great many similar flowers for the attention of the same kinds of insects. As a consequence we find the forms separating their blooming times so as to come, some before, and some after, the maximum of the group, though the maximum of the whole will probably coincide with the position of the maximum of the dominant forms. The maximum point, then as a rule, at least, marks the point of origin of the group, but the struggle for existence requires a departure from it. Instead, therefore, of indicating a point of convergence for the group, the maximum point is the place of divergence, so that there is no law [2] according to which the forms tend to concentrate at this point. If one of the forms which has departed from the maximum point comes to fill a much more favorable position, it may finally give rise to so numerous a progeny of forms that the maximum of the group will change position and no longer coincide with the point of origin.

In looking over my tabulations with these considerations in mind I note that, as a rule, incipient and closely allied species bloom synchronously, while more distinct species, and species of different genera are more likely to be widely separated. In large genera containing numerous closely allied species, which indicates a more recent origin, most of the species bloom together, and it is a notable fact that such genera have a potent influence in determining the maximum point of the groups to which they belong. Thus the species of buttercups (*Ranunculus*), violets (*Viola*), St. John's wort (*Hypericum*), tick-trefoil (*Desmodium*), golden-rods (*Solidago*), boneset (*Eupatorium*), sunflower (*Helianthus*), aster, milkweed (*Asclepias*), verbena, and smartweed (*Polygonum*), with rare exceptions, bloom simultaneously. The maximum of the buttercup family (Ranunculaceae) coincides with that of *Ranunculus*, that of Leguminosae with the position of *Desmodium*, while the maximum

[2] In the migration of some highly specialized groups which MacMillan calls "north bound," I think there has been a retardation of the blooming seasons which has tended to concentrate the species and thus form late maxima.

of Compositae is determined by the position of the asters, *Eupatorium*, golden-rods and sunflowers.

As a result of the divergence of the blooming periods from the maximum point of the group we find that plants come into competition with species of other groups, but as a rule they can stand this better than competition with their own allies.

Trees have such a remarkable influence upon one another and upon the herbaceous flora that they should properly, it seems, be considered separately. The fact that most of them agree in being wind-pollinated is an additional reason for this course. Of 488 indigenous insect-pollinated plants, upon which my observations are based, only 18 are trees. On examining the curve for the insect-loving flora (Fig 1, Plate VIII, 5 species to the millimetre),[3] it will be observed that the maximum is reached in August. At this time 187 species are in bloom, but not a single tree is among them. The flowers of trees are so interfered with by their own leaves and the leaves of other trees that it is disadvantageous for them to bloom after the leaves are fully developed. In the case of wind-pollinated trees it is obvious that, if the leaves were developed before the flowers, the process of pollination would be greatly impeded by the leaves interfering with the free circulation of the wind and catching the pollen which is intended for the stigmas. This fact makes trees an evident exception to Mr. Clarke's generalization, though they are frequently less specialized than their later flowering allies. In the anemophilous nettle family (Urticaceae) there is a marked contrast between the blooming times of the trees and herbaceous species, as stated by Mr. Clarke. Thus the elm, hackberry and mulberry are early, while the hop, hemp and wood-nettle (*Laportea*) are late.

In the case of insect-pollinated trees the conditions are similar to those of wind-pollinated ones, and they generally

[3] Unless otherwise specified, the curves given in this paper are on the scale of one species to the millimetre, *i, e.*, the height of the curve in millimetres indicates the number of insects flying, or flowers in bloom at a given time. The details on which the curves are based will be given elsewhere.

bloom before the leaves are developed, the witch-hazel notably after the leaves have fallen. The leaves act in an equally disadvantageous way, by concealing the flowers so that insects do not easily find them. Before the leaves have appeared in the woods, the trees which depend upon insects for pollination are very conspicuous and have a good chance of being attended by the insects which are attracted by their own flowers and by the flowers of the herbaceous plants which grow under their protection. Later, when the woods become shady, there are few herbaceous flowers, and few insects to attend the trees if they should bear flowers dependent upon them. The rose family (Rosaceae) is of particular interest, since of the larger families it contains the greatest number of trees., and as its maximum is early (Fig. 14, Plate VIII), it is the only one of the entomophilous tree-producing families, which is in a favorable position for giving rise to aborescent forms. The first to bloom is the service-berry (*Amelanchier*), and the trees, *e. g.*, the plum, cherry, apple and hawthorn, coincide pretty nearly with the maximum of the family, though it is significant that the latest species are herbaceous. As the season advances, the flowering of trees and of herbaceous plants which grow under them is evidently cut short in correlation with the appearance of the overshadowing leaves.[4]

While it is not my intention to discuss wind-pollinated plants specially at this time, I think that their blooming seasons may be explained by reference to their competition among themselves and with the insect-pollinated flora. Even in herbaceous plants it seems that the spring might reasonably be expected to be the most favorable for pollination, since they would be less likely to be overtopped by the later plants which become increasingly more luxuriant. But at different seasons they can readily occupy positions unfavorable to entomophilous plants, and in summer they may endure the competition of the entomophilous flora better than that of an indefinite number of plants depending upon the wind, or better

[4] One of my favorite botanizing grounds shows a great variety of vernal flowers, but after the appearance of the leaves is covered by a uniform growth of the anemophilous wood-nettle (*Laportea canadensis*).

than to resort to insect-pollination. In the cases of anemophilous Ranunculaceae, such as meadow-rue (*Thalictrum*), and Compositae, such as rag-weed (*Ambrosia*), it is probable that wind-pollination has been resorted to by way of avoiding competition with their allies, and it is notable that these plants bloom near the maximum points of the families to which they belong.

A comparison of the insect-pollinated Monocotyledons (Fig. 7, Plate VIII) with the general entomophilous flora (Fig. 1, Plate VIII) yields a more striking contrast than would result from a comparison of the two groups in general, for the former loses the large wind-loving families of sedges and grasses, the latter blooming late, and the general flora loses the early blooming wind-loving trees. In this group we observe that the terrestrial species, without regard to specialization, bloom early, while the aquatic ones are late. This I think is largely a result of the severe competition of the former with the highly specialized terrestrial flora, a competition from which the aquatics have been largely relieved by their position.

As regards those of the Liliiflorae having the carpels separate (apocarpal) and those having them united (syncarpal) I am unable to agree that the former are more highly specialized, and so must consider that their blooming time is opposed to the proposition that the more highly specialized flowers bloom later.

The curve for the Choripetalae (Polypetalae and Apetalae, Fig. 2, Plate VIII.—5 spp. per mm.) shows a maximum in August of 73 species, and a secondary maximum in April of 71 species, and the curve diminishes from both to about the middle of June, when there are 49 species in bloom. Of the Hypogynae (Fig. 3, Plate VIII.—2 spp. per mm.) 43 species bloom simultaneously in May, after which they pretty regularly decline. With the addition of the hypogynous Apetalae, the maximum remains the same, but there is a secondary elevation in August. The Perigynae (Fig. 5, Plate VIII. —2 spp. per mm.) show an August maximum on account of the strong preponderance of the Leguminosae. Among the

Epigynae (Fig. 4, Plate VIII) the ginsengs (Araliaceae), dogwoods (Cornaceae), wild ginger and pipe-vine (Aristolochiaceae), as Mr. Clarke observes, come early. In regard to the Umbelliferae (Fig. 18, Plate VIII), however, my observations do not show them "in fullest sovereignty in July and August," for at that time only four species bloom together, while there are 11 species in flower in May. Contrary to Mr.Clarke's theory, the more highly specialized Epigynae (Fig. 4, Plate VIII) show a stronger tendency than the Perigynae (Fig. 5, Plate VIII to form an early maximum.

Even the less specialized of the two dominant families of Perigynae (the Rosaceae, 14) does not equal the Umbelliferae in the formation of an early maximum, *i. e.*, it does not decline so rapidly from the early elevation. I think that the Umbelliferae are more highly specialized than the Myrtales (Lythraceae and Onagraceae) and so reverse the order of Mr. Clarke's theory. But the maximum of the Myrtales (17) anticipates that of the Leguminosae (15).

Of the hypogynous Sympetalae (Gamopetalae), the phloxes (Polemoniaceae), water-leaf family (Hydrophyllaceae) and borage family (Borraginaceae) are early; of 12 species all but one begin to bloom before June, and only two are in bloom after July 1st (Fig. 20, Plate VIII). The more numerous mint family (Labiatae, Fig. 13, Plate VIII) and Scropulariaceae (Fig. 19, Plate VIII) predominate in the summer. Observations on the Epigynae indicate that the flowers of the honeysuckle and madder families (Caprifoliaceae and Rubiaceae) are most abundant in the last of May and first of June. The lobelias and campanulas are most abundant in August. Of all the dominant families, the, Compositae (Fig. 21, Plate IX.—2 spp. per mm.) show the latest maximum. The tendency of the more highly specialized Sympetalae to form a strong late maximum is more marked than in the case of the more simple Choripetalae.

In order to illustrate to what extent the time of blooming of plants is correlated with the time of flight of insects, curves are reproduced showing the periods of the principal flower-loving insects, *e. g.*, the bees (Fig, 24, Plate IX), the other

Aculeate Hymenoptera (Fig. 25, Plate IX), the butterflies (Fig. 23, Plate IX), and the flies (Fig. 22, Plate IX)—all on the scale of five species to the millimetre. No curve is made out for the whole because these curves agree in showing a maximum for July, which, of course, would determine the position of the general maximum.[5] The bees are by far the most important, since they depend upon flowers both for their own food and for that of their young. As a rule, except in the case of the cuckoo bees, which lay their eggs upon food deposited by the host bees, the female bees are provided with brushes of hair upon which they carry pollen, the essential part of the bee-bread, upon which the larvæ feed.

In a previous examination of the curve for the Choripetalae (Fig. 2, Plate VIII) there was observed a maximum in August, a secondary elevation in May, and an intervening depression in June.

With the principal exception of the Leguminosae (Fig. 15, plate VIII), these plants have horizontally expanded regular flowers, with readily accessible nectar and stamens exposed so that the pollen is easily collected or eaten. The Leguminosae generally have lateral irregular flowers, with the nectar concealed and deep-seated, and intricately concealed pollen, for which reason they will be separated for special consideration. Now, since the maximum for the Choripetalae coincides with that of the Leguminosae, the separation of this family will change the maximum of the group to the secondary point. There are two families of insects which are particularly fond of simple flowers with easily accessible nectar and pollen—the less specialized bees (Andrenidae, Fig. 26, Plate IX.—2 spp. per mm.) and the flower-flies (Syrphidae, Fig. 36, Plate X.—2 spp. per mm.)—and they both have more species flying in early spring. There is no question but that the strong predominance of the more simple Choripetalae is, to a great extent, correlated with the early predominance of the Andrenidae and Syrphidae. The flowers of the buttercup family (Ranunculaceae, Fig. 9, Plate VIII) and of the Rosaceae (Fig.

[5] My phaenological observations are most defective for August. I expect to find the maximum of the general anthophilous insect fauna a little later.

14, Plate VIII) with their numerous stamens are the particular favorites of the less specialized bees, and it would be fairly impossible for them to be so efficiently attended late in the season. No flowers are more convenient for the imperfectly adapted flower insects than those of the parsley family (Umbelliferae, Fig. 18, Plate VIII). While the later blooming species are visited by a more numerous set of insects, the visitors are less efficient. The flowers are somewhat neglected by the higher bees (Apidae, Fig. 27, Plate IX.—2 spp. per mm.). so that in order to secure the most useful set of visitors it is desirable to bloom early, under the maximum of the Andrenidae. I have shown that the harbinger of spring (Erigenia), the earliest spring flower, has a larger percentage of bees among its visitors than any other plant of the family, and that the early blooming species with simply concealed nectar show more bees as visitors than those with deep-seated nectar but blooming late. On consulting the curves for bees (24) and other Aculeate Hymenoptera (25) and flies (22), it will be observed that early in the season the predominant insects are bees and flies, so that by early blooming the less specialized flowers gain an advantage similar to that secured by the more highly specialized in a later season in concealing their nectar, *i. e.*, they acquire a higher proportion of the more efficient flower insects. The pond lilies (Nymphaeaceae) come in bloom late, probably on account of their aquatic habitat and have a long period, probably on account of occupying a position free from the competition of overshadowing form, but they are pollinated by late-flying bees and flower flies; and I have named two species of bees (*Halictus nelumbonis* and *Prosopis nelumbonis*) on account of their close economic relation to these flowers. The violets (Fig. 16, Plate VIII) are spring flowers, there being no normal late-blooming indigenous species. Those with the lateral petals bearded are adapted to the mason bees (Osmia, Fig. 31, Plate IX), small greenish species with pollen-collecting brushes on the ventral surface of the abdomen, which fly early apparently to avoid competition with the large allied genus of leaf-cutter bees (Megachile, Fig. 32, Plate IX). When visiting the violets these

bees turn head downwards and hang upon the beards of the lateral petals while they collect the falling pollen. The violets also have an important pollinator in *Andrena violæ* of the spring group of *Andrena* (Fig. 35, Plate X). The swamp rose-mallow (*Hibiscus lasiocarpus*, Fig. 6a, Plate VIII) has a blooming time correlated with the time of flight of a characteristic American bee (*Emphor bombiformis*, Fig. 6b, Plate VIII), its principal pollinator; the bee in turn depending on the *Hibiscus* for its pollen. Another interesting case of correlation in appearance and mutual dependence is, that of an alum-root (*Heuchera hispida* Fig. 11a, Plate VIII) and a little bee (*Colletes aestivalis*, Fig. 11b, Plate VIII).

Returning to the Leguminosae (Fig. 15, Plate VIII) we observe that of the species which form the August maximum all are adapted to the most intelligent of the highest specialized genera of bees. Quite a number are bumble-bee flowers. The ordinary flowers have the stamens declined to the lower side and are best fitted to be pollinated by the leaf-cutter bees (Fig. 32, Plate IX), which have abdominal brushes for collecting pollen, and I think that the position of the family in general should be regarded as associated with the flight of these bees. Two species adapted to bumble-bees, a ground plum (*Astragalus mexicanus*) and a false indigo (*Baptisia leucophaea*), occur early, which they may do without going out of the range of bumble-bees (Fig. 30, Plate IX) and they each gain an advantage by avoiding competition with a late blooming congener also depending upon bumble-bees. But no other ordinary papilionaceous flower blooms out of the flying time of the leaf-cutter bees. The very earliest of the family, the red-bud (*Cercis canadensis*) has the stamens declined to the lower side of the flower, so that the pollen is easily gathered by the mason bees (Fig. 31, Plate IX), which we have already mentioned as having abdominal brushes, like the leaf-cutters (Fig. 32, Plate IX), but fly early. The early appearance of the red-bud seems to be influenced by the early flight of these bees, though it is not exclusively visited by them. Finally, therefore, with regard to the blooming phenomena of the Choripetalae, we close with the propositions that the early preponderance of the

more simple open flowers is determined by the early predominance of the less specialized bees, and that the late preponderance of the more complicated closed flowers is correlated with the flight of the most specialized bees, leaf-cutters, bumblebees, etc.[6]

The Sympetalae (Gamopetalae) consist of flowers with more or less deepseated nectar and often with closed complicated flowers. They are adapted to bumble-bees or to the more highly specialized bees in general, to butterflies or to miscellaneous more or less long-tongued insects. An interesting case is that of flowers of *Steironema* which are associated with the flight of *Macropis steironematis,* a bee which as far as observed depends exclusively upon these flowers for its pollen. The wild potato vine (*Ipomoea pandurata*) is dependent mainly upon two bees (*Entechnia taurea* and *Xenoglossa ipomoeae*). The flowers of ground cherry (*Physalis*) bloom during the flight of two species of *Colletes* (*C. willistonii* and *C. latitarsis*), upon which they depend almost exclusively for pollination, the little bees on the other hand, obtaining all of their pollen from these flowers. The dominant mint family (Labiatae, Fig. 13, Plate VIII) is principally adapted to the higher bees, although some having degraded irregular flowers with exposed stamens are adapted to miscellaneous insects. The figwort family (Scrophulariaceae, Fig. 19, Plate VIII) is an even more exclusive bee-flower family, most of them being adapted to bumble-bees, and appearing late. The earliest species, *Collinsia verna,* is one of the most highly specialized and looks like a papilionaceous flower. The upper lip and the lateral lobes of the lower lip represent banner and wings, while the middle lobe represents the keel, and it performs the same function for it contains the stamens, which instead of lying against the upper wall of the corolla, as is usual in the family, are declined across the tube. We have observed that most of the Leguminosae with declined stamens are adapted to bees with abdominal

[6] The early blooming of the dominant families of Choripetalae, as well as the Liliiflorae, must also be explained in part as correlated with their woodland habitat, their decline being influenced by the appearance of the leaves on the trees.

pollen brushes (*Megachile,* Fig. 32, Plate IX), and now in the case of this flower we find the principal visitors to be bees of the genus *Osmia* (Fig. 31, Plate IX); so that it joins the red-bud and violet in appearing during the flight of these bees. The figwort (*Scrophularia*) and *Symphoricarpus* come late in adjustment to the flight of the wasp workers and Eumenidae to which they are specially adapted. The late position of the lobelias is what might be expected, since they are dependent upon the visits of the higher bees (Fig. 27, Plate IX). We come finally to consider the great highly specialized family of sunflowers, nigger-heads, thistles, etc., (Compositae, Fig. 21,–2 spp. per mm. Plate IX) which shows a conspicuous late maximum and is the best example of Mr. Clarke's theory, though I think one of the easiest to explain without it.

The composite heads, which give the name to the family, are composed of florets arranged generally in a flat-topped horizontal layer which forms a convenient resting place for all kinds of insects. There is abundant nectar for the longer tongues and abundant pollen exposed for the least specialized to feed upon or to collect. From these peculiarities and from their great numbers we find this family to be of more importance to the general insect fauna than any other. The most important visitors are the higher bees, especially bumble-bees (Fig. 30, Plate IX), the leaf-cutters (Fig. 32, Plate IX) and *Melissodes* (Fig. 29, Plate IX), and lower Aculeate Hymenoptera in general (Fig. 25, Plate IX), the butterflies (Fig. 23, Plate IX), the flies, including many flower-flies (Fig. 36, Plate X), the tachinids (Fig. 37, Plate I), the conopids (Fig. 38, Plate X), and the bombylids (Fig. 39, Plate X). The occurrence of the maximum of the family after that of the general flower-loving insect fauna, I think, is largely due to the abundance of the goldenrods, asters, etc., which have rather small heads and less-deeply concealed nectar. The position of these flowers is accounted for in correlation with the position of the usually smaller insects by which they are attended, viz.; the little bees belonging to the genera *Calliopsis* (Fig. 34, Plate IX), the late *Colletes* (Fig. 33, Plate IX), the autumnal group of *Andrena* (Fig. 35, Plate X) and the Bombylidae (Fig. 39, Plate X)—all important guests

and all having late maxima. These late Compositae have few competitors outside of their family and so are favorably situated, although the insect fauna has begun to decline. We will now leave the Sympetalae with the general statement that the late preponderance of the irregular flowers is explained in connection with the late preponderance of the higher bees, and that of the regular flowers is accounted for in the late maxima of the highly specialized long-tongued insects.

We have reviewed the principal groups of insect-pollinated plants and have noted a correspondence, more or less well marked, between their blooming seasons and the seasons of the insects upon which they depend. In different positions we find bumble-bee flowers and, although they all occur within the time of flight of these insects, it is not easy to explain why one of these flowers comes at one time and another at another time. Under the maximum of the buttercup family (Fig. 9, Plate VIII) we find a bumble-bee flower in the larkspur (*Delphinium tricorne*) and under the maximum of Leguminosae (Fig. 15, Plate VIII) another in a tick-trefoil (*Desmodium canadense*). We may say that the larkspur comes earlier because it had its origin in an earlier group. The flight of the bumble-bees, however, cannot be left out of consideration. It is obvious that a bumble-bee flower cannot arise at a time when the attentions of bumble-bees cannot be secured, so that the flight of the bees determines the time within which these flowers may have their origin. When a flower undergoing modification to suit bumble-bees changes its characters so that it no longer comes in competition with its allies, it becomes a competitor of other bumble-bee flowers. A point at which many of these are in bloom simultaneously would naturally be an unfavorable time, unless the new form should early offer more inviting attractions. If the blooming time were long, the attentions of the bees would be likely to be most constant at the point where there were the fewest competitors, and so finally the blooming time would tend to be limited to this point. Or if the earlier flowers were better tended, so that they became the most effectually fertilized, the blooming time would tend to become earlier. Some flowers we find far from the "tension" points

of their groups, having no doubt shifted to take a more favorable position under the competition of other flowers. Thus the earliest member of the mint family (Fig. 13, Plate VIII), is a bumble-bee flower, and some of the earliest of the figwort family (Fig. 19, Plate VIII) are adapted to these insects. The larkspur itself is anticipated by four bumble-bee flowers belonging to more highly specialized families. We would, therefore, expect to find bumble-bee flowers at favorable points of origin or shifted to favorable positions, and the whole group of flowers so disposed as to share the services of these long-tongues with as little interference among themselves as possible. Of the sixty-four species on which the curve (Fig. 41, Plate X) is based the different forms succeed one another from the first of April until the middle of October in such a way that not more than twenty-five species are in bloom at the same time. Twenty-six have completed their flowering by the last of June. We will compare this curve with that for bumble-bees. The first bumble-bees which fly in the spring are the females; in May, June and July the workers appear; and finally in July, the males. The workers are more abundant and even more industrious than the females, and the males are frequently quite numerous and efficient flower visitors. In making a curve for bumble-bees (Fig. 30, Plate IX), therefore, I have introduced each sex as an element so that the maximum coincides with the flight of the three forms, and I think this is the only way to indicate in a curve the function of the genus as a pollinating agency. Now if we compare the curve for bumble-bees (Fig. 30, Plate IX) with the curve for the bumble-bee flowers (Fig. 41, Plate X) we find a well marked coincidence.

The curve for the other flowers adapted to the higher bees (Fig. 44, Plate X) indicates a more pronounced maximum, evidently because the higher bees in general show a more marked preponderance in summer. Of sixty-nine species on which the curve is based, thirty are in bloom simultaneously at the maximum point.

Now as observed above, the lower bees (Andrenidae, Fig. 26 Plate IX) prefer erect simple flowers with easily accessible nectar

PLATE VIII.

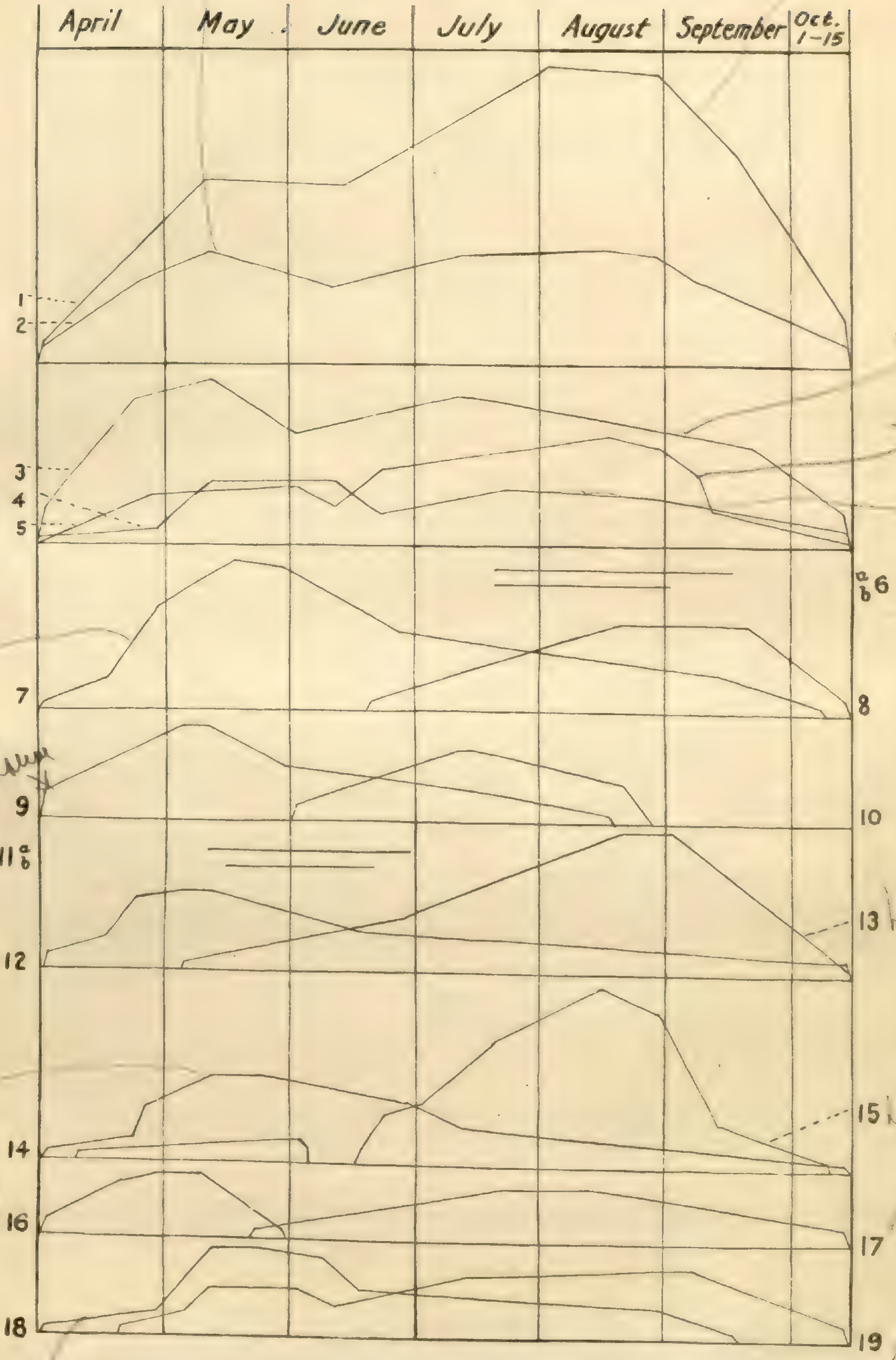
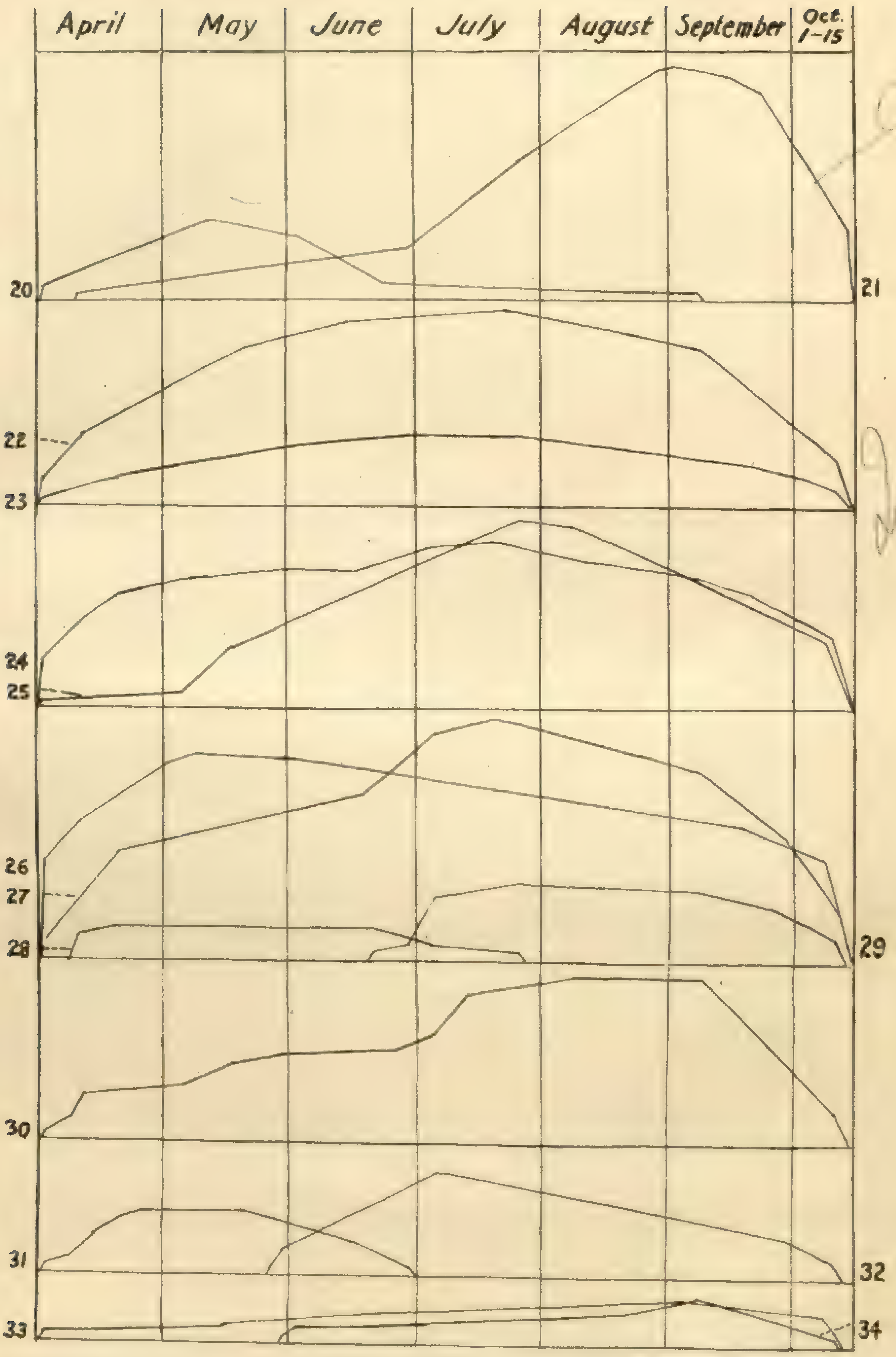

April
May
June
July
August
September
Oct. 1–15
1
2
3
4
5
a
b
6
7
8
9
10
11 a b
12
13
14
15
16
17
18
19

PLATE IX.


April
May
June
July
August
September
Oct. 1-15
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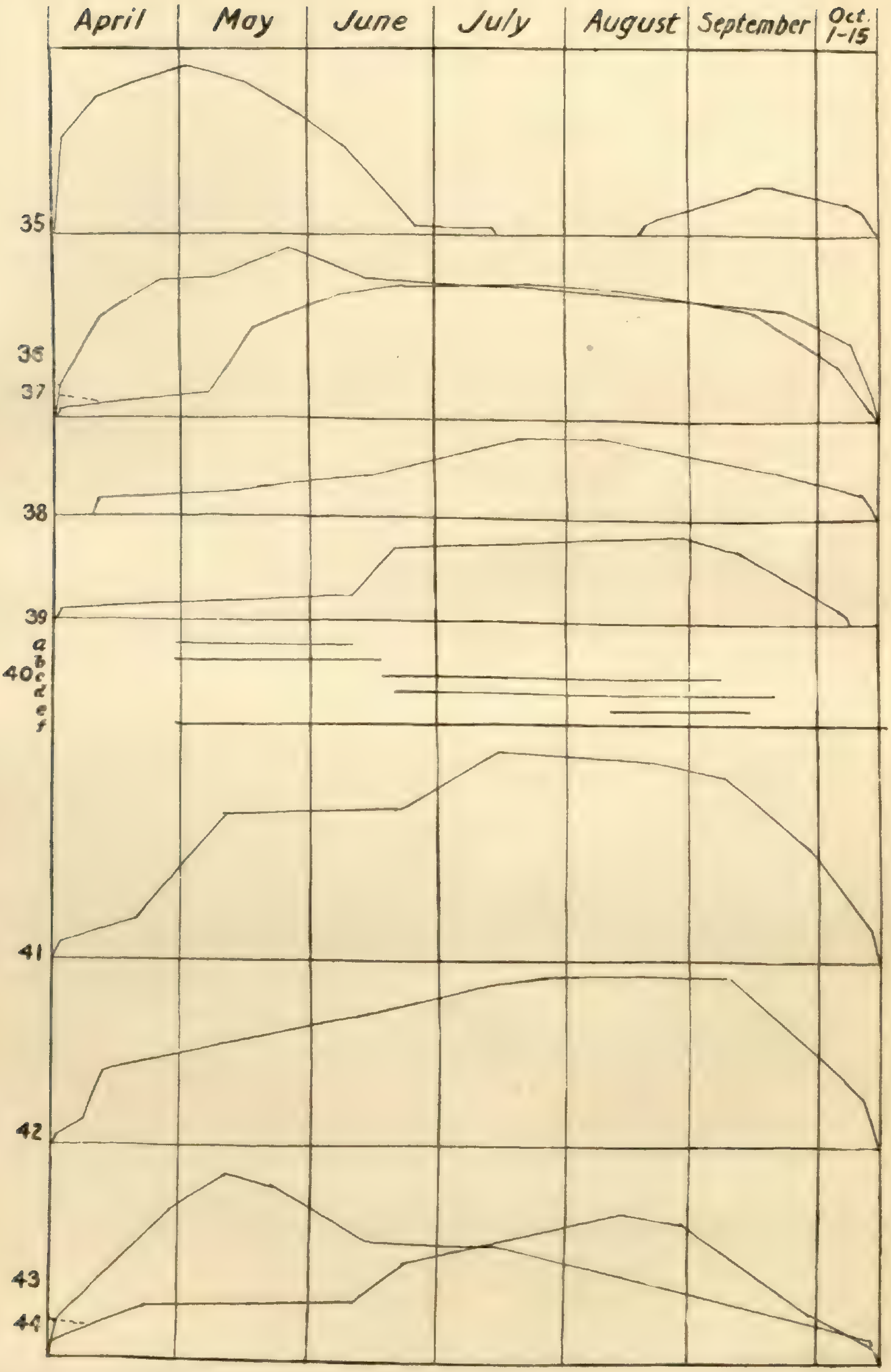
32
33
34

PLATE X.


April
May
June
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August
September
Oct. 1-15
35
36
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38
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a
b
40c
d
e
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42
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44

and exposed pollen, especially flowers with numerous stamens. There are many flowers which have a structure of this kind and on which these bees actually preponderate over every other family of flower-loving insects. But since they do not hold a clear preponderance over the total of the other groups, it is hardly safe to call the flowers "Andrenid-flowers." The large family of flower-flies (Syrphidae, Fig. 36, Plate X) has the proboscis adapted for eating pollen and for sucking, though as a suctorial organ it is not so highly specialized as in many other flies. For this reason the flowers which are best fitted to supply the Andrenidae with nectar and pollen are also the most favorable for the nectar and pollen-eating Syrphidae, and when these two families are taken together they generally show a preponderance over all other visitors, or so many that the flower may be properly regarded as adapted to them. Putting such flowers together, I find that the *ensemble* of their blooming periods forms a curve like Fig. 43, Plate X, with a strong early maximum.

There are few evident butterfly-flowers. The best marked of them are commonly visited by long-tongued bees and flies. The species which are referred to this category form a long low curve, which we will compare with the curve for butterflies (Fig. 23, Plate IX).

Fig. 40, Plate X shows the time of flight of the ruby-throated humming bird (f) and the time of blooming of the flowers specially pollinated by it.—a. the painted cup (*Castilleia coccinea*); b. the wild columbine (*Aquilegia canadensis*); c. the trumpet creeper (*Tecoma radicans*); d. the spotted touch-me-not (*Impatiens fulva*); e. the cardinal flower (*Lobelia cardinalis*). There are two early species blooming together and going out about the time that the trumpet creeper (c) comes in, and three late species. The position of painted cup (a) is peculiar, but is much more favorable than in competition with the three late species. It will be noted that two species are in competition most of the time, while it is only a short time that one is alone or three are together. The spring and autumn migration of the bird may account for the tendency of these bird flowers to form an early and a late group.

The insects which contain what may properly be called flower-loving groups, viz.; the Hymenoptera, Diptera and Lepidoptera, are the most highly specialized orders of insects. The particular anthophilous groups we have observed to have their maxima in the late summer. With the exception of the bees, which are true flower-insects, depending upon flowers and showing true mutual correlations, the flight of these insects may be more properly regarded as determined by conditions favorable for their young. Flowers and flower-groups blooming at times favorable for utilizing them should be regarded as correlated with the time of flight of the insects, and not visa versa. Of the bees we have observed that the highest specialized (Apidae) show a late maximum while the less specialized (Andrenidae) show an early maximum, which is explained largely as a result of competition of the former. In view of the fact, therefore, that the most highly specialized flower-insects are most abundant in late summer it is but natural that there should also be a preponderance at the same time of the most highly specialized flowers whose development has been simultaneous with them. In so far as it applies to insect-pollinated flowers I think we have here the answer to Mr. Clarke's question "Why should there be a correspondence between the course of the flower seasons and the system of floral evolution?"

We have observed that the group in which the fact of the correlation of a high specialization and late flowering is very conspicuous is the Sympetalae, and it must be admitted that the proposition of Mr. Clarke in regard to the late blooming of plants of southern derivation, must enter as an explanation. In his admirable work on the Metaspermae of the Minnesota Valley, Mr. MacMillan has shown that the Sympetalae (Metachlamydeae) are especially characterized by a north-bound movement.

Throughout this paper it has been implied that the time of blooming was determined by the flight of the pollinating insects and also determined and limited by the competition of plants one with another. In verification of this view turn to the case of introduced plants. It is well-known that intro-

duced plants seem to flourish much more prosperously than the natives, and this is explained as owing to the fact that in a new country they escape the competition of forms which have been constantly undergoing modification to hold them in check. Many of our introduced plants, however, are not characterized so much by the facility with which they crowd out native species as by their habit of adjusting themselves to conditions induced by man, and of filling places rendered by him unoccupied; and in this work many of them no doubt have undergone a course of selective training in older lands. But it is sufficient for our purpose to start with the fact that introduced plants are to a great extent relieved from the pressure of competition which holds among the indigenous plants, and, therefore, as regards blooming, would be expected to flower longer. And this is in fact the rule. In those genera in which we have both indigenous and introduced species the former bloom for a short time (*Sisymbrium canescens, Stellaria longifolia, Cerastium nutans*, sunflowers, thistles) while their introduced congeners bloom much longer (*Sisymbrium officinale, Stellaria media, Cerastium vulgatum, Helianthus annuus, Cnicus lanceolatus*). The introduced species of Cruciferae, Caryophyllaceae, Portulacaceae, Malvaceae, Leguminosae, Umbelliferae, Compositae, Scrophulariaceae, Labiatae and Polygonaceae present cases of long blooming which are not equaled by any native species of the respective families.

Some native plants which have a strong tendency to occupy waste grounds also show a tendency to bloom for a long time. A similar disposition is manifested in the cases of plants having small flowers infrequently visited by insects and often self-pollinating. Many originally aquatic plants and others which have been forced to take to the water are, like introduced plants and the degraded entomophilous flowers, relieved from the severer competition of terrestrial plants and in a similar way show a tendency to prolong their blooming periods.

In the case of the indigenons flora there is a well marked disposition to limit the blooming period in anticipation of the advancing winter. The direct effect of cold is not obvious, but there is an evident tendency not to prolong the period

until the conditions should become unfavorable for the perfection of the fruit. In the case of the north bound groups (Sympetalae especially) we might infer that the northward movement would retard the blooming time so as to make it later in beginning, and to prolong it far into the autumn. I have thought that this might have something to do with the late preponderance of these groups. The curves for Labiatae (Fig. 13, Plate VIII) Compositae (Fig. 21, Plate IX) and Leguminosae (Fig. 15, Plate VIII) seem to show the influence of the approaching cold to an unusual degree, for they fall off quite suddenly from the late maxima. In the case of introduced plants we have observed that they show in a low degree the limitations which beset the indigenous species and so tend to prolong their periods. The advancing winter brings conditions, however, which they cannot escape, and it is but natural that they should show the direct effect of cold more than the indigenous plants. They form a low curve which is relatively higher at the 15th of October than any other curve. Although only about one-tenth of the entomophilous species, the introduced species show two-fifths of the flowers in bloom at the middle of October. Their blooming time is actually cut short by the cold.

An interesting fact in regard to the curves for the dominant groups of flowers is that they decline towards June. In the curves for the general flora and the Choripetalae and its groups (1–5) it will also be observed that there is a depression in June. The same occurs in Scrophulariaceae (Fig. 19, Plate VIII), while the Leguminosae (Fig. 15, Plate VIII) show an actual gap, as far as I have observed. This results mainly I think from the appearance of the dense shade in the woodlands, which limits the blooming seasons of the vernal woodland species. No plant can become a strong competitor of the vernal species unless it blooms early enough to fill out its season before the shade appears. The late species are thus required to modify their seasons so greatly before they are prepared to enter the vernal woodlands that the trees finally become as effectual a barrier against them as against the late blooming of the early species. Suppose that the Compositae should give rise to an

early flowering group which should enter the woodlands and become competitors of the spring flora, as *Antennaria* and some species of *Erigeron* now do. The curve for Compositae would finally show a June depression. These conditions must always keep the groups from taking the positions required by Mr. Clarke's theory.

INSANITY IN ROYAL FAMILIES. A STUDY IN HEREDITY.

By Alice Bodington.

In the Section of Psychology at the annual meeting of the British Medical Association, 1894, a most interesting and suggestive paper was read by Dr. W. Lloyd Andriezen, on the steady increase of the whole group of neuroses. In this paper the following sentence occurs; "Nature stamps out the insanities herself; they end in sterile idiocy. But before such a consumation can be reached, a vast and interesting progeny has to be gone through, exhibiting all the intermediate phases of the insanities and the criminalities." Dr. Andriezen speaks of the conclusions to be drawn from the history of the notorious "Jukes family" in America, and promises to enlarge on this subject in a forthcoming paper.

Now, it is doubtless almost impossible to overestimate the importance of the study of the Jukes family as an example of inherited degeneration and vice amongst the dregs of society. But, as I read Dr. Andriezen's paper, a subject for a study of hereditary insanity at the opposite pole of the social system, suggested itself to me; namely its effects in the royal families of Modern Europe. For many hundred years the problem of hereditary insanity has been worked out in some of these families, and under circumstances which enable a student to follow out all its intricacies, since the connection of members of royal houses can, for obvious reasons, be more readily traced than those of private individuals.

The subject has interested me ever since I saw, many years ago, the great grandchild of a king suffering from the most violent form of mania I ever beheld. In this case the hereditary taint had passed through two generations without development, whilst the ancestor, in whom insanity can first be traced, was a contemporary of Henry the Eighth! Moreover the insanity of this ancestor partook of exactly the same char-

acter as that of his descendant in Windsor Castle two hundred years later. It is written of the "good Duke William" of Celle that when" in old age he was deprived of both sight and reason, he had occasional glimpses of mental light, when he would bid his musicians play the psalm tunes which he loved."

In this article I will speak chiefly of the Spanish and Austrian branches of the house of Hapsburg; and of the Russian house of Romanoff.

The Spanish Hapsburgs. In the year 1496 Joanna, second daughter of Ferdinand of Aragon, and Isabella of Castile, was married to Philip the Handsome, Son of Maximilian, Emperor of Germany, and Mary of Burgundy, daughter and heiress of Charles the Bold. It is to be doubted if any marriage in the whole course of history has been attended with more direct consequences than this, since Mary of Burgundy brought with her the fairest provinces of the Netherlands as her dower, which were thus exposed to the diabolical cruelty and bigotry of Spanish rule.

In 1506 Philip the Handsome died, as lately discovered historical documents appear to prove, from poison administered by his wife. Joanna, who had always been weak-minded, was possessed by an insane jealously of her husband, and after his death she became completely mad. Fits of fury alternated with melancholy, and the sad life of this ancestress of long lines of kings ended in complete dementia. Joanna's jealously of her husband did not cease with his death, but for years she persisted in carrying his body about with her, and violent accesses of fury occurred if any woman approached the corpse.

It is not likely that the insanity in the royal family of Spain began with Joanna, and it would be peculiarly interesting in this and other cases to trace the taint from its very beginning.

Joanna's sister Catherine was the mother of the "Bloody" Queen May of English History, who showed the characteristic moral insanity and ferocious bigotry of so many of the Spanish Hapsburgs. A granddaughter of Joanna's married to Duke William V. of Juliers and Cleves, went mad, and her husband shared the same fate. Her son, who was demented, died, and

so "Nature" in this instance, quickly "stamped out insanity and idiocy"; the double taint being peculiarly fatal.

Another sister of Joanna's married into the Portuguese House of Braganza and in Napoleon's time one of her descendants—queen in her own right—died raving mad. Numerous children of Ferdinand and Isabella were sickly and died young, and one is inclined to think it would have been a "crowning mercy" if all the others had shared the same fate.

But we must return to the descendants of Joanna who wore the Spanish crown. Her son, the Emperor Charles V. of Germany, was a sovereign of unusual ability, distinguished in war and still more in diplomacy. On his father's side it must be remembered that he came of a singularly healthy stock; his grandfather Maximilian had been in his youth a veritable hero of romance, brave and chivalrous to a fault, and in the guise of a simple knight errant had won the heart and hand of his bride, the richest heiress of Europe. We shall meet with a great grandson of Maximilian's who inherited all his brilliant qualities; but not in the legitimate line of descent.

But let us turn our eyes from the potentate who held the balance of power in Europe in his hands, to the man who, hardly past the prime of life, voluntarily laid down his power, and retired to spend his last years in the Convent of Yuste. Here, the melancholia which had remained latent during the earlier life of Charles V., gradually took possession of him. He insisted that his funeral obsequies should be performed, and the prayers for the dead read for him as he lay in sackcloth and ashes in his coffin in the convent chapel.

From the shock of this ghastly ceremony the once powerful Emperor never recovered; a fever took possession of him and in a few days he breathed his last.

His successor, Philip II, was one of the most gloomy and ferocious bigots the world has ever seen. Like a poisonous spider in its web, so from the palace prison to the Escurial, did this cruel and treacherous despot devise blackest ruin and death, with one stroke of his pen condemning a whole nation to death. A determined attempt was made to carry out this incredible sentence, which was only frustrated by the most

heroic bravery on the part of the doomed people. The case of Philip II may perhaps justly be considered one of moral insanity, for to the very end of his career he never showed the slightest consciousness of having done evil. Dying by inches in the slow torture of a most horrible disease, he displayed the utmost patience, fortitude and resignation to the will of God; his end was that of a saint and a martyr as he fixed his last expiring glances on the image of his crucified Saviour. This man who had caused rivers of blood to shed, who had brought fire, famine, torture and death in its most hideous forms to countless thousands of his fellow-creatures; who was treacherous to friends and foes alike; who was privy to the death of his own son; died in absolute peace with his conscience and his God! Those who ascribe infallible and divinely instilled instincts to conscience would do well to study the career of Philip II.

The career of Don John of Austria, half-brother to Philip II, may be noticed here, as illustrating the advantages of change of environment and of fresh blood where insanity is latent in a family. He was the son of Charles V by Barbara Blomberg, daughter of a respectful citizen of Ratisbon, and in his moral and mental qualities closely resembled his great grandfather, Maximilian, whose romantic early career earned him the title of the last of the knights-errant. His singularly brilliant career was ended by his too early death at the age of 33; the victim indirectly, if not directly, of the cold and cruel policy of his half-brother Philip II. As a mere youth, Don John of Austria had gained one of the decisive battles of the world, in the naval victory of Lepanto which rolled back that advance of Turkish power which was threatening the destruction of Europe. But this brilliant success raised the sleepless jealousy of his brother, and Don John was sent to the Netherlands, there to eat his heart out with repeated vexations and disappointments, purposely inflicted by the cold, crafty tyrant of the Escurial. No trace of the influence of his mad grandmother appeared in the buoyant spirits, the trusting, generous disposition, and brilliant courage of this illfated young hero.

The career of the wretched Don Carlos, eldest son of Philip II, may fitly be mentioned here. At an early age he showed a furious and wholly ungovernable temper, a delight in cruelty for its own sake and a propensity to ignoble vices; in short he displayed every characteristic of moral insanity. Thrown into prison by his brother, fits of fury, and of exhaustion from his vices were till lately judged to be the cause of his death, but modern researches show that he was one of the many secret victims of his merciless parent.

During the lives of the two sovereigns who succeeded Philip II, the sword of Damocles which hung over the royal house of Spain remained suspended, only to fall with crushing weight on the pitiable Charles II, in whom "Nature stamped out insanity in sterile idiocy." It must, however, be remarked that Nature took nearly two hundred years in accomplishing this process, even in conditions of the most unfavorable environment, and after repeated alliances with the tainted blood of Austria and Portugal. Charles II showed all the signs of the final stages of race degeneracy. Until his sixth or seventh year he was unable to stand, and was nursed on the knees of the ladies of the Court; his prognathous misshapen jaw could not be closed and he was constantly slavering; moreover his impotence, whilst it did not prevent the immolation of two young princessess as his nominal wives, was so well-known in Europe that intrigues, with regard to the succession to the Crown of Spain, went on throughout his miserable life Semi-idiotic as was his mental condition, he was capable of suffering all the mental tortures that superstition could inflict, and his dying bed was surrounded by venal priests who threatened eternal damnation if his successor were not named according to their desires. So ended the direct male line of the Spanish Hapsburgs, descendants of the mad Joanna through her eldest son.

The Austrian Hapsburgs. The history of the Austrian Hapsburgs, descended from Joanna through her second son Ferdinand, presents much brighter features than those of the Spanish house. It is difficult, if not impossible, to apportion the share which the pernicious teaching of the Jesuits and the

gloomy traditions of the Spanish Court had in forming the characters of the two Monarchs of the Austrian line, who remind one respectively of Don Carlos and Philip II; or how large a share might be ascribed to hereditary taint.

Rudolf II (1576—1612) was the son of Maximilian II, one of the most enlightened and honorable princes of his time, and one who, strange to say, held the balance scrupulously even between his Protestant and Roman Catholic subjects. But Rudolf, unfortunately for himself and Germany, had been trained in the gloomy Court of Spain, and was a mere tool of the Jesuits. His temper was moody and variable, and he was subject to outbursts of uncontrollable passion, followed by abject submission to his advisers, the Jesuits, who had gained complete ascendancy over him.

If in Rudolf II we meet with many salient characteristics of Don Carlos, so in Ferdinand II. we have a type of character as inexpressibly odious as that of Philip II. To the ferocious bigotry of Ferdinand II, more than to any other cause, may be ascribed the Thirty Year's War, one of the most hideous wars that history has ever recorded. More than twelve million of people, at a moderate estimate, perished in this fratricidal strife; wolves ravened through the burnt and deserted villages; men killed their children and dug up the bodies of the dead for food; and, before its close, Germany lay bleeding and exhausted at the feet of France, and has only in this century recovered her strength. To ferocious bigotry Ferdinand added the blackest treachery and a cold blooded and diabolical cruelty. But atrocious as was his character we must remember that he, like Rudolf II was a tool of the Jesuits, then at the zenith of their power, and numbering in their ranks the most highly trained intellects of their time; whereas the cruelties and treacheries perpetrated by Philip II were spun out of his own brain.

The immediate predecessor of the present distinguished wearer of the Austrian crown was certainly of weak intellect, weeping when his physicians forbade him a favorite dish "Kaiser bin ich, und Nudeln muss ich haben" he sobbed. On another occasion his Minister hoped that the Emperor, who

was unusually silent at a cabinet council, was for once intent on affairs of state, when he suddenly exclaimed "I have sat at this window for an hour, and so many cabs, carriages and wagons have passed in that time." Not one word had he heard of the affairs of State! Yet Ferdinand was not so weak minded but that in calm times he could officiate as a crowned puppet. I think therefore we may say that the Austrain Hapsburgs have almost entirely escaped the taint of insanity; the line has produced numerous sovereigns distinguished by exceptional abilities and virtues such as Maximilian II, Maria Theresa, Joseph II, and the present Emperor Francis Joseph. On the abdication of his uncle, who wept for the dumplings, Francis Joseph, in most troublous times, was placed at the helm of State, and up to the present time, by the personal affection and the confidence he inspires, and by marvellous political tact, he has kept his heterogeneous dominions under his rule; perhaps the only man living who could have held such jarring elements together.

The House of Romanoff. Peter the Great, the founder of his family's greatness, presented a strange admixture of opposite qualities. One of Peter's brothers was imbecile, and the history of the Romanoff family leaves little doubt that there goes in them a tendency to insanity, latent or declared.

In Peter the Great we see on the one hand a man of extraordinary and commanding genius, whose ideas made, and still rule, modern Russia: a man who by sheer force dragged barbarous, semi-Asiatic Muscovy into the comity of European nations; and who with far seeing glance recognizing the vital necessity of a navy for Russia, did not disdain with that end in view to work as a common shipwright. On the other hand we see a drunken boor; subject to paroxyms of ungovernable fury; ferociously cruel; in a word showing the worst attributes of an utter savage.

Truly here we see the "beast within the man." But it seems as though his very superiority of brain makes the beast in man to so transcend all evil qualities of a beast of prey tha one can hardly wonder that the human imagination conceived devils as the moving agents of such horrors. No wild beast's

brain could conceive or execute the prodigies of cruelty, debauchery and lust that characterize the beast within the man where it has gained the upper hand.

There is no doubt that Peter the Great, like other great geniuses, as for instance Mahomet and Napoleon, suffered from epileptiform attacks, and in his fits of frenzy was not responsible for his acts. Another factor may be taken into account in estimating the character of Peter the Great, namely his prolonged bouts of drunkenness, during which he would swallow incredible quantities of brandy. In these orgies Peter would find pleasure in pouring brandy through a funnel down the throat of some wretched courtier who had succumbed sooner than himself; a practical joke ending in the death of the victim. But the most gruesome incident in the life of Peter the Great was the death of his son Alexis. Alexis much resembled the ill-fated Don Carlos; his wife, a German princess, after five years of misery refused medicine and food, and was glad to find an escape in death; he was violently reactionary in his opinions, and Peter honestly believed that his hardly won reforms would be utterly undone if Alexis were his successor. But after the discovery of a formidable plot on the part of his son, Peter, determined to extort the whole truth, ordered Alexis to be flogged. Finding no one who would venture to execute his commands, Peter, mad with rage, proceeded to flog Alexis, (as he used formerly to flog his first wife,) till he left the wretched prince for dead on the floor; when he stalked out exclaiming "You need not alarm yourselves, the devil is not ready for him yet." During the next twenty-four hours the miserable sufferer was again twice flogged, and under the third application of the knout he died. The father's repentance was terrible and lasting; as chief mourner he followed his mangled son to the grave, crying as David did for Absalom, that he would willingly have died for his son. And when he again lashed himself into insane fury, it was to wash out his son's death in the blood of those who had tempted him to crime.

The next sovereign who calls for remark, Peter III, was grandson of Peter the Great through his daughter Anna. If

we say that Peter III repeated every vice of his grandfather's without any of his virtues we shall have said almost enough; he was a drunken, madly vain, dissolute savage, and after being dethroned, was assassinated by the orders of his wife, Catharine II.

Paul I was not unlike Peter III in his general characteristics, and he too was assassinated. Alexander I, the rival of Napoleon, presents the greatest of contrasts to the Romanoffs we have hitherto seen; he inherited the excellent qualities of his mother, Catherine the Great, whilst he was a stranger to her vices. Like Joseph II of Austria, he was too enlightened for his environment; his schemes for good were frustrated; his noblest hopes for his country disappointed; a deep melancholy settled on his spirits, and like Joseph II he welcomed death.[1]

The character of Alexander I was nearly repeated in that of Alexander II, his nephew, the "Tzar Liberator." As we survey the men of the Romanoff family in the present century, though we find many of its collateral members showing an undesirable atavism, yet the actual wearers of the Russian crown, with all their mistakes, must be credited with the honest intention of doing their best for their people. In short the final result shows that a ruling family may have a worse ancester than a drunken epileptic, who was at the same time a man of supreme genius! Unfortunately the race, once so strong, has been tainted through the female side with consumption, which promises to play worse havoc in two generations than epilepsy or drunkenness in two hundred years.

I can offer here only a slight and imperfect sketch of the lives on which a more fortunately situated enquirer might work. I have alluded only to the best known direct lines of succession, but a wide field of interest lies before the student who will follow the ramifications of European royal families through the female side. There have been constant intermarriages between the Hapsburgs and the Bourbons. Perhaps it is not too far-fetched to ascribe the superior abilities of

[1] "I am dying," said Joseph II, when his benevolent schemes for the good of Hungary had been utterly frustrated, "My heart must be made of stone not to break."

the House of Orleans to marriages which brought fresh blood into the family; whereas the alliances of the elder branch of the House of France were of the nature, known to stock raisers as "breedings-in-and-in."[2]

In any case it would be worth while to trace carefully—so far as possible—the origin of the characteristics of the French, Spanish and Neapolitan Bourbons, as compared with those of the House of Orleans: the three former bigoted, unprogressive, unable to assimilate the advanced ideas of their age; having after the French Revolution "learned nothing and forgotten nothing," and the House of Orleans descended from the younger brother of Louis XIV, abreast of all the ideas of their time, highly intelligent, cultivated and progressive. In the house of Orleans we are watching a rising family; in the other branches of Bourbons, families mentally and morally sinking.

Another interesting branch of enquiry, would be to trace the origin of the insanity in the Danish, Bavarian and Belgian royal families. The curious coincidence between the form of insanity which characterized the good Duke of Celle in the sixteenth century, and that from which his descendant, George III, suffered two hundred years later, I have already alluded to. But why did the taint of insanity remain latent for so many years, and can some marriage be traced which caused its recrudescence? I think it might be found in the family of the Princess of Wales, mother of George III; but I have no means here of tracing the lineage of that princess.

But having started this train of enquiry with the intention of cursing the whole group of Neuroses, as productive of in-

[2]Phillippe brother of Louis XIV married Charlotte Elizabeth of Bavaria; one of the most strong minded and original personalities of her time.

Philippe's only son married a natural daughter of Madame de Montespan's; and had his ears soundly boxed by his mother when she heard of the engagement. Louis-Phillippe-Joseph 1747—1793, married the only daughter of the Duc de Penthievre.

The mother of the late Comte de Paris was a Princess of Mecklenburg.

On the other hand Louis XIV, elder brother of Philippe, first Duke of Orleans, married the only daughter of Philip IV of Spain; Louis XVI married Marie Antoinette of the Austrian House of Hapsburgs, and the direct male line became extinct with the intensely narrow and bigoted Comte de Chambord, whose mother belonged to the Neapolitan branch of the Bourbons.

calculable hereditary evils, I find myself by no means, Balaam-like, "blessing them altogether" but arriving at the conclusion that with ordinary care and discretion the tendency to mental instability is not more mischievous, than the taint of strumous disease, of syphilis, of cancer,—in short of any of the other Protean ills with which civilized society is permeated. Fortunate indeed is the family which comes of a good, hearty, gouty stock; amidst a choice of evils this tendency to gout seems one of the least!

It also appears to me that the attempt to "stamp out" insanity, though it may seem easy on paper, would prove impossible in practice. There is an unfortunate correlation between various forms of disease which would oblige society to stamp out the greater part of the civilized portion of the human race, if a serious effort were made to stamp out insanity, one member of a strumous family may develop disease of the lung; another succumb to cerebral meningitis; a third become insane. The child of a drunken father may become insane or be a habitual drunkard, but he may also, if the drunken father be Philip of Macedon, prove an Alexander the Great. The child of syphilitic parents may develop a train of ills of which insanity may be one; or the hereditary taint may leave one generation untouched and destroy the next, as in the case of the House of Valois. You can drown the weakest puppy or kitten in a litter, but if you destroy your physically weak human beings, you may put an end to a Newton, a Voltaire or a Walter Scott. What human being, unendowed with supernaturel discernment, could tell where the stamping out was necessary?

One line of action only appears safe and practicable, and it is one which find an increasing number of advocates; namely the Sterilization of the Unfit. I do not use this expression in the sense of surgical interference, though this course is also often advocated; inevitably injustices would be done, mistakes would occur, ending perhaps in death; public opinion would be aroused, and no one would be allowed to interfere with the marriages of criminals and imbeciles for some generations to come. But what must necessarily be done if society is not to be swamped with the criminals, the idiots, the imbe-

ciles, the congenitally defective, which she now so sedulously cares for, is that the unfit should be kept under kindly but strict supervision; the sexes strictly separated, and a *life long surveillance* kept up. And for practical purposes no cognizance can be taken of the Unfit till they are or become chargeable to the State. An expensive and troublesome course, it may be said, but what is the expense of the life-long care and surveillance of the present generation of the Unfit, compared to the incalculable expense and mischief of allowing them to propagate their species without check?

For conclusion I hope any readers who may be interested in the subject of this paper, will read an article in the Arena for November 1894, entitled "The Relation of Imbecility to Crime," by Martha Louise Clerk. This lady speaks from a wide practical experience of the care of imbeciles, and she eloquently expresses opinions, much like those I have arrived at, upon more theoretical grounds.

THE SIGNIFICANCE OF ANOMALIES.[1]

By Thomas Dwight, M. D., LL. D.[2]

This subject, which after consultation has been chosen for our discussion this year, is one which for a long time has interested and puzzled me extremely. I look forward with great pleasure to the light which I hope will be thrown upon it by distinguished members of this Association. For my part I propose merely to state some of the difficulties which it seems to present and suggest one or two general conclusions which seem to me to be justified.

Probably no biological phenomena have been more confidently explained by heredity and atavism than rudimentary organs and anomalies. The former, of constant occurrence, though perhaps of transitory existence, have been happily compared by Darwin to letters in words which are no longer sounded, but which were pronounced at an earlier stage of the language.

Anomalies are the occasional appearance of structures normal in other animals. That these are found very commonly in man everyone knows. Whether they are found equally commonly in animals is a matter of uncertainty. Mr. Dobson believes that man as the type of a domesticated animal is particularly liable to them and that in wild animals they are extremely uncommon. To this may be opposed the great frequency of anomalies in negroes. If I am not mistaken, other rebutting evidence is furnished by comparative anatomy. The same explanation has held for these; but as their gradually increasing numbers have brought more accurate study, serious difficulties have arisen. It is clear that if an anomaly in man is to be called a reversion, either the species in which it is normal must have been in the direct line of ancestry, or there must have been a common progenitor. Evident as this

[1]Read at the meeting of the Association in New York on December 29th, 1894, to open the discussion.

[2]President of the Association of American Anatomists.

is it has been grossly disregarded, not only by popular scientists, but by some from whom better might be expected. To point out the animal in which a certain anomaly is normal has been too often offered as an explanation. Critical study makes many difficulties apparent. These are vastly increased when we consider that a satisfactory explanation must account not only for certain anomalies, but for all. At the very least there must be no case clearly at variance with the explanation.

All anomalies have not the same significance. Certain ones represent structures widespread throughout mammals, some of them even in other classes of vertebrates. Three of these may be mentioned: the supra-condyloid process, the third trochanter, the para-mastoid process. Of the first there is usually no trace in man. The second is represented at most by a roughness of doubtful interpretation, in my opinion it is usually wholly absent. The third is wanting, or a mere point. The occurrence in man of a third trochanter is very common, that of the supra-condyloid process uncommon and a really large para-mastoid process is a great rarity. None of them occur normally in the Simiidæ (the anthropoid apes). Of these structures the most general is the supra-condyloid foramen. In the primates it is practically universal among the Lemuroidæ, but among the Anthropoidæ it occurs only among some of the smaller monkeys,—some of the Cebidæ.

The third trochanter also is almost universal among the Lemuroids as a rudiment, and in some species reaches a moderate development. There are traces of it in some of the smaller monkeys, and it is occasionally seen in the gibbons and the chimpanzee. I have tried to maintain that the true third trochanter in man, occurring very often on delicate bones, is different from the rough line for the insertion of the glutæus maximus.[3]

The para-mastoid process is, if I am not much mistaken, rudimentary or wanting throughout the primates.

When therefore, we find a supra-condyloid process which with the completing ligament, represents the supra-condyloid foramen, to account for it atavistically the shortest leap is to

[3]Journal of Anat. and Phys. Vol. XXIV.

the Cebidæ. In the case of the third trochanter we can hardly stop short of the lemuroidæ in spite of the probability that they and the anthropoidæ came from a common stem. For a really large para-mastoid process we must go beyond the primates altogether. There would be some comfort to be gained from the insectivora were we in the least justified in putting them among the ancestors of the primates, for several genera have a well-developed para-mastoid process, the supra-condyloid process is general, and the third trochanter is frequently represented, still it is neither general nor very prominent. For its greatest development we must turn to the odd-toed ungulata, and now descent is out of the question.

It may be opposed to this that we have no right to assume that a certain well developed anomalous process in man must necessarily be accounted for by inheritance from a form possessing an equal large one; that it is enough to show the existence of a clearly marked process in a common ancestor and to assume that its great development in the anomaly is an accident of no significance. I am quite willing to grant that this objection has weight. Still when we account by atavism for the supra-condyloid process we must admit that the gulf between the structure of man's body and that of one of the Cebidæ is so great that this explanation would hardly serve were it not absolutely necessary for a theory.

Another class of anomalies are those, which far from being general features, are found in certain highly specialized animals which can be included in no possible scheme of descent. An instance is the fossa praenasalis, not to be confounded with the rounding of the border of the nares which is practically universal. It occurs in human skulls of a low order and presents a development which is seen in no animal. It is usually more or less distinctly marked in the seal tribe. I have seen it poorly marked in the gorilla. Here atavism is wholly at fault. The Pronator Quadratus muscle in man very rarely sends a prolongation downwards to one or more carpal bones on the radial side of the wrist. I am not aware that this is normal in any mammal. Whence then does it come? Testut would have it the homologue of a muscle which Humphry

describes as pronator manus is Cryptobranchus Japonicus and of one described by Meckel in chelonians. It is curious that Macalister has found this arrangement in a tiger and I have found it in both arms of a chimpanzee, which I believe is an unique observation. This shows a tendency in the carnivora and primates to similar variation which is not inherited.

Some of these anomalies present a likeness that is very probably accidental, possessing no significance whatever. Such is the peculiar union of the different pieces of the sternum by which the manubrium fuses with what should be the first piece of the meso-sternum. Is the fact that this frequently occurs in the gibbons to be looked upon as anything but a coincidence? Does the occasional perforation of the thyroid cartilage by the superior laryngeal nerve in man derive any significance from the fact that this is found in the seal? Again, when we find in man some anomaly of the aortic arch or of the great arteries springing from it, we know that the usual course of development of the branchial arches has been disturbed. Need we look further than to some accident in the individual? Has the fact that the abnormal arrangement is normal in some animal any significance? These are questions which admit of no certain answer.

The second class of anomalies are those of most difficult explanation. They naturally suggest an analogy with the cases of the occurrence of similar structures in widely separated animals, such as the bill of a duck and of the Ornithorhyncus, the paddle of the cetacean and of the ichthyosaurus. The obvious retort is that these resemblances are superficial; but they are none the less true. Indeed, similar arrangements for a similar purpose are found which can in no way be called superficial. A very good example is furnished by Mr. Dobson.[4]

The Pyrenean water mole (Myogale) of the Insectivora, which has very elongated digits, has an enormously developed fibular flexor and a rudimentary tibial flexor. On the true moles the tibial flexor is larger, but the arrangement is

[4]On the Comparative Variability of Bones and Muscles, etc. Journal of Anat. and Phys. Vol. XIX. p. 20.

the same. Now the Bathyergus martimus of South America which has the habits of moles, but is really a rodent, has a precisely similar disposition of the parts. "Here the larger fibular flexor, as in Myogale, has forced the tibial flexor inwards, so that the latter is attached to the head of the tibia internal to the attachment of the popliteus; and its tendon being separated in the foot from that of the fibular flexor, is attached, precisely as in the true insectivorous moles, to the tibial margin of the basil phalanx of the hallox, developing, as it crosses the ento-cuneiform articulation, a broad sesamoid ossicle." Mr. Dobson then asks: "How happens it that in certain widely separated species, in no way connected by descent from a common ancestor having similar peculiarities, separation of this tendon from that of the fibular flexor and attachment to a different part of the foot has occurred in a perfectly similar manner?" He finds this very difficult to answer and can only suggest that the arrangement in question being the best, it has been reached independently in both species by natural selection.

Those of us who look upon natural selection pure and simple as quite inadequate to what is already required of it, will not be disposed to call upon it to do double duty. Those who like myself, believe in design and in a limited evolution founded on law, while they may explain by teleology such instances as the last mentioned, can by no means apply that doctrine to anomalies.

The mechanical theory that the action of certain muscles should account for certain processes, such as the third trochanter, is not admissable. I have shown that this anomaly occurs in savage races in which presumably all live pretty much the same life, and that further it occurs at too early an age to be caused by any strain in the individual.[5] Even were this not so there are many anomalies which obviously can have no connection with mechanics.

It is easier to destroy than to build. I can offer no substitute for the theories I reject which would itself stand criticism. I will merely offer the following as justifiable conclusions.

[5] Loc. cit.

First, similarity of structure, either in the ordinary animal or in the one showing variations, is not necessarily a proof of descent. Second, those very irregularities, which we call abnormal, point to a law in accordance with which very diverse animals have a tendency to develop according to a common plan. This be it noted, in no way denies the possible influence of surroundings.

EDITOR'S TABLE.

THE Societies of Naturalists, Morphologists, Physiologists and Geologists met together during the late holidays in the ample halls of the Johns Hopkins University, in Baltimore. The Geologists had met previously independently of the other societies. Their presence at Johns Hopkins added much to the interest of the meetings, and permitted some exchanges of hours on occasions of especial interest. The Naturalists listened to an excellent address from the retiring president, Dr. Minot, and had an instructive debate on the influence of the environment on animal life, conducted by Messrs. Osborn, Hyatt, Brooks and Merriam. Impressive papers were read before the Morphologists by Drs. Wilson and Hyatt; the former embryological, the latter paleontological. Three of the societies sat down to dinner at the Stafford House on Friday evening, and did justice to the exceptional hospitality of the host, Mr. Moale, himself a graduate of Johns Hopkins. The place of next meeting has not been decided on, but it is hoped that it will be such as will suit the convenience of several societies additional to those that met at Baltimore. These are the Anatomists, who met this year in New York; and the newly organized societies of Botanists and Psychologists.

These bodies all consist of actual workers in their respective fields, and they are, therefore, with a few others, the only scientific societies in this country in which strict qualifications are requisite for membership. Our contemporary, the American Geologist, in a recent editorial article, advocates the establishment of academies of science in the several States of the Union, as was done by the NATURALIST many years ago. It points to Indiana as furnishing an example worthy of imitation, since the legislature has made an appropriation for a biological survey of the State, to be conducted by its Academy of Science. The prime condition of prosperity for an academy of science must always be the effective character of its membership. This will always be especially important where State aid is granted. Some practical test of fitness for membership is necessary. One such test would be membership in one of the affiliated societies referred to above. A State Academy of Science composed of all the members of these societies resident within its borders, would be a very effective body.

SCIENTIFIC exploration is becoming popular in the United States as the desire to extend knowledge increases. Apart from Government

expeditions, Philadelphia was for a long time the centre of activity of this work, as the Arctic expeditions of Kane, Hays and Peary and the South American expeditions of Orton and Smith testify. Abbott and Donaldson Smith the African explorers, are Philadelphians, as is also Rockhill, who traversed Thibet and China a few years ago. Ann Arbor University has sent two expeditions to the Philippine Islands, and Iowa University sent one to Central America, and one to the Arctic regions northof Mackenzie's River, of which we gave an account in the last number of the NATURALIST. New York sent Rusby to Bolivia and Peru, and more recently Weber to Java. There have been several expeditions nearer home, as to the West Indies and Labrador and Central America. We do not refer to Government expeditions, which were more frequent formerly than of recent years.

RECENT LITERATURE.

The Mesozoic Echinodermata of the United States.[1]—This memoir, issued as Bulletin No. 97 of the U. S. Geol. Survey, is the first of a series of reports on the American fossil radiates. A complete bibliography of the subject is followed by a systematic review of the various forms, in which brief descriptions, giving merely the characteristics necessary for accurate determination of species, is the rule. The geological range of the American Mesozoic species is shown in tabular form, and, in conclusion, there is an index to the various terms employed by those who have written upon the Mesozoic Echinodermata of the United States.

The memoir is profusely illustrated, the plates, 50 in number, occupying over half the volume. Many details of structure not given in the text are shown in the drawings. This book fills a need, as no general work on the subject exists, but students were compelled to search through a much scattered literature for information and identification.

Tertiary Rhynchophorous Coleoptera of the United States.[2]—This monograph is the first of a series upon the fossil insects of this country by Dr. S. H. Scudder. In its preparation, besides a number of specimens which could not be definitely placed, the author has examined 753 Rhynchophora, of which 431 come from Florissant and 320 from the Gosiute fauna. In the introduction Dr. Scudder gives in tabular statements (1) a comparative view of recent and fossil Rhynchophora; (2) the relative importance of the families of group; (3) the relative abundance of the orders of insects in different Western deposits.

In conclusion the author makes the following statements regarding the Rhynchophorous fauna of the American Tertiaries in general:

"(1) The general facies of the fauna is American, and somewhat more southern than its geographical position would indicate.

"(2) All the species are extinct, and though the Gosiute Lake and the ancient lacustrine basin of Florissant were but little removed from

[1] The Mesozoic Echinodermata of the United States, by W. B. Clark. Bull. No. 97, U. S. Geol. Survey, Washington, 1893.

[2] Monographs of the United States Geological Survey, Vol. xxi. Tertiary Rhynchophorous Coleoptera of the United States, by Samuel Hubbard Scudder, Washington, 1893.

each other, and the deposits of both are presumably of Oligocene age, not a single instance is known of the occurrence of the same species in the two basins.

"(3) No species is identical with any European Tertiary form.

"(4) A very considerable number of genera are extinct, often including a number of species.

"(5) Existing genera which are represented in the American Tertiaries are mostly American, not infrequently subtropical or tropical American, and where found also in the Old World are mostly those which are common to the North Temperate Zone. A warmer climate than at present is indicated.

"(6) There are no extinct families, but in one instance an extinct subfamily with numerous representatives.

"(7) The Tertiary European fauna is nearer than our own Tertiary fauna in the relative preponderance of its families, subfamilies and tribes."

"These conclusions are almost identical, word for word, with those reached from a study of the Tertiary Hemiptera of the United States, although in that study a far more meagre representation of the Gosiute fauna was at hand."

The Fishes of Pennsylvania.[3]—In an octavo volume of 139 pages Dr. Tarleton Bean gives in a concise form descriptions of all the species of fishes found in the State of Pennsylvania, with notes upon their common name, distribution, size, habits, reproduction, rate of growth and mode of capture. The descriptions are based upon specimens contained in the collection of the United States National Museum, and the popular notes have been obtained by personal investigation and, in part, by compilation from the writings of Goode, Gill, Cope and Jordan.

The most important fishes are represented on 35 plates, of which 15 are handsomely colored. Dr. Bean's well-known reputation as an ichthyologist is fully sustained by this work, and it fully justifies the State in incurring the expense necessary to its publication. Its value is both utilitarian and educational.

[3] The Fishes of Pennsylvania, by Tarleton H. Bean, M. D., Harrisburg, Pa., 1893.

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General Notes.

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An Expedition to Labrador.

Some scientists and explorers have devoted considerable time and attention to the exploration of certain sections of Labrador, notably Prof. Packard, Mr. Stearns, Prof. Lee, Henry G. Bryant and Mr. A. P. Low, of the Dominion Geological Survey.

The reports and writings of these men interested me so deeply that I resolved to devote a summer to exploring in Labrador, and so I organized a small party last June, with the intention of visiting the interior table-lands of the peninsula by way of Hamilton or Grand River, already explored by Mr. Bryant to the Grand Falls. The party, besides myself, consisted of Mr. Howard Bucknell, ornithologist; Mr. G. H. Perkins, geographer, and Mr. G. M. Coates, botanist.

We got together a complete camp outfit, two Rushton canoes for use on the rivers, a set of surveying instruments, collecting materials, etc., and thus equipped we took passage with "Dr. Cook's Arctic Expedition of 1894," on the steamship Miranda, since famous on account of the numerous accidents which befell it, and its final abandonment in Arctic seas.

We left New York on July 7th last, and enjoyed a pleasant voyage to North Sydney, Cape Breton, where we stopped to take in a supply of coal. Here we visited the copper mines and the great coal mines, which extend for miles beneath the sea. From Sydney we went on to St. Johns, N. F., where we stopped for a few hours in order to repair one of our compasses. Two days after leaving St. Johns, a quarter after eight o'clock on the morning of July 17th, the steamer, being surrounded by a heavy fog, collided with an iceberg. Great commotion arose among the passengers, which, however, quickly abated, for it was discovered that no serious damage had been inflicted. It was decided to put into Cape Charles, on the southern coast of Labrador, for repairs. Here we remained for several days, and devoted ourselves to making collections of the flora and fauna of this section. The country about Cape Charles is composed of low hills formed of granite, syenite and hornblende. The student of geology will find here trap-dykes and veins of various kinds, also remarkable examples of anticlinal and synclinal strata exhibited on the eroded surfaces of the

almost perpendicular cliffs along the shore.. The country is almost destitute of trees, but there is a great profusion of mosses, principally sphagnum, and reindeer moss abounds. We procured here a beautiful specimen of the Canadian lynx (*Lynx canadensis*), but saw no evidences of small mammals other than the rabbit (*Lepus americanus*), of which two specimens were procured. We saw several seals, but did not have the good fortune to capture any.

As the Miranda was obliged to return to St. John's for further repairs, we embarked from Cape Charles on the regular mail boat for Independent Harbor, the entrance to Sandwich Bay, about sixty miles south of Hamilton Bay, where I had originally intended to begin my explorations. I was obliged to change my plans on account of the accident to the Miranda, and the illness of Mr. Bucknell, who had been taken sick shortly after leaving New York. When we arrived at Independent Harbor we secured passage in a small boat to Separation Point, a narrow point of land separating the White Bear from the Eagle River. Here we made a cache of our provisions, and, with our two small boats, started to explore the White Bear River. On the second day out from Separation Point we came to a considerable cataract, sixty feet in height. Mr. Bucknell's condition was now so serious that I deemed it unwise for him to proceed any further, and so I pitched camp at the foot of the falls, and left him in charge of Mr. Coates, to collect ornithological and botanical specimens, while Mr. Perkins and myself took the smaller boat, and provisions for ten days, and went around to explore the river. We ascended it to a distance of about one hundred and ninety miles from its mouth. We found the streams at this season of the year very shallow, with numerous rapids, which rendered its ascent extremely difficult. Frequently we were compelled to remove our trousers and boots and push the boat along, the water not being deep enough to float the boat while we remained in it. After passing a rapid, or rattle, as it is called by the half-breed Labradorians, there was usually quite an expanse of water extending for some distance; this is called by the natives a "stiddy." Our progress along these "stiddies" was comparatively easy. About fifty miles from the coast, and on either side of the river, rose hills and peaks from 1400 to 1600 feet in height. These were covered with a dense primeval growth of spruce and tamarack, with an occasional clump of birch-trees, and great beds of moss from a foot to three feet in depth. Great numbers of dwarf cornel (*Cornus canadensis*) abounded. We came across numberless erratic boulders of labradorite, as well as other boulders of all sizes, which lined the bed and sides of the stream.

As we penetrated into the interior of the country and neared the source of the river, the physical aspect was entirely changed, owing to the absence of forests and the less variety and abundance of moss. The boulders increased in numbers, and were covered with lichens of various kinds. After we had made the first fifty miles we saw no evidences of animal life whatever. The river terminated in a chain of small lakes. On either bank we found vegetation, principally willows, all bent down stream, and the bark scarred and scratched, indicating that the water in the spring of the year had risen to a height of eighteen or twenty feet. At the lower portion of the river we found peculiar semicircles of boulders, ranging in size from the dimensions of a hen's-egg to two and three feet in diameter. We learned that this fantastic arrangement of the boulders was due to the peculiar action of the ice during the spring, the boulders being transported by the ice and dropped in this position by eddies. At first we thought that these peculiar circles of stones might have been arranged by the early inhabitants of Labrador.

When we returned to camp we found that Mr. Bucknell's condition had not improvod, though he and Mr. Coates had managed to make a very creditable collection of birds and plants. After a day's excursion on the south fork of the White Bear River we returned to Separation Point. I sent Mr. Bucknell over to Cartwright, the most southern and eastern Hudson Bay trading-post on the Labrador shore, and, with Mr. Perkins and Mr. Coates, continued the exploration of the Eagle and Paradise Rivers. We found the Eagle River much deeper, narrower and more rapid than the White Bear, and only about half as long. The Paradise River was very broad in comparison with the other two, as it flows through a more level section of the country. Here we found an abundance of plants which did not grow in the more mountainous districts, and we came across a number of large lakes, upon which were a great many species of water-birds not before seen on the trip. We ascended this river only about forty miles.

Lining the banks of the river were dense growths of willows; but these did not show in any way the effects of high water. We found seals all along the river as far as we went, and procured about twenty skins, principally of the Harbor seal (*Phoca vitulina*), though we also captured specimens of the *Phoca fœtida*, *Phoca hispida*, *Phoca grœnandica* and *Cistophora cristata.*

This river, like the Paradise and Eagle, abounded with trout and salmon, which afforded us rare sport and kept our table well supplied.

On the north side of Sandwich Bay is a mountain 1900 feet high, on which caribous (*Rangifer caribou*) are very abundant. We ascended this mountain and shot several specimens of caribous, and also found here a vein of labradorite outcropping on the surface that measured forty-two feet in length and three feet in width, with a dip of 47° east of south. We also found small veins of mica and great quantities of iron ore, also copper in the form of malachite. Hornblende, gneiss, syenite and granite were the principal rocks. We also came across great quantities of small crystals of garnet, some of them very pretty. In several places surrounding Sandwich Bay, and on each of the rivers we discovered glacial striations running southeast in direction. Some of these were ten or twelve feet long, and were distinctly cut in the smooth, polished surface of the rocks. At Cartwright, and, in fact, throughout the section that we explored, we found but few full-blooded Eskimos. The inhabitants of southern Labrador are a mixed breed of people, Eskimo mixed with various nationalities, mainly English and Danish.

The Labrador waters are noted as among the greatest fisheries in the world for cod and salmon. There are about 25,000 fishermen along these shores, who come chiefly from Newfoundland, and depend wholly upon fish for their living. This past year the fisheries have been a total failure, both in Labrador and off the coast of Newfoundland. Great suffering has been reported from Newfoundland, but from the condition of affairs we saw in Labrador the sufferings of the Newfoundland fishermen must be slight in comparison to those of the destitute Labrador people.

Just before we left Cartwright on our return voyage, a severe storm took place, and nearly three hundred shipwrecked fishermen were brought to Newfoundland by the Labrador mail steamer.

The relationship of the Eskimos of Labrador to those of Greenland has been a matter of some controversy. I wish to call attention to a little fact in regard to the clothing of these two peoples, which may have some bearing upon the question of their relationship. On the lower edge of the *timiak*, or coat, of the Labrador Eskimo, in front and behind, are two ornamental appendages in the form of flaps; the anterior one is but a few inches in length, while the posterior flap reaches in some instances below the knee, being narrow at the top and gradually broadening out like a beaver's tail. This is highly decorated on the back with various colored pieces of seal-skin from which the hair has been removed, and with a border of another color from which the hair has not been removed. These flaps are

to be found among the Eskimos of Greenland, especially among those above Cape Cook. Among them, however, the posterior flap is but a few inches in length, and during the severe Arctic winters the Greenland Eskimos tie these flaps together between the legs, outside and over the *nanookies*, or trousers, and so make of them a support and a protection against the cold. The Eskimos of Labrador are more or less given to ornamentation of various kinds, while those of North Greenland are intensely practical and display no ornamentation in their dress.

The idea occurred to me that the Eskimos, in travelling northward along the American side, conceived the idea of tying these flaps between their legs, and as the people parted company and split into sections, one section retained the flaps for ornamental purposes, while another section, going still further north into Greenland, preserved the flaps for practical purposes only.

The Eskimos and Indians of Alaska, as far as I have been able to ascertain, have neither the front nor the back appendage on their *timiaks*. However trivial this suggestion may seem, I wish that men concerned in tracing the relationship and origin of the Eskimo tribes would give this matter some attention.

As regards our natural history collections, we obtained thirty-nine species of mammals and seventy-seven species of birds, all of which, with the exception of two species of birds, are listed by Prof. Packard in his work, entitled " The Labrador Coast."

Mr. Coates made a large collection of plants, but as yet these have not been identified. Five butterflies not given by Prof. Packard were procured. We were not prepared for marine collections, but, nevertheless, we secured a number of echinoderms, one of which was a magnificent twelve-rayed star-fish. Of batrachia two species were procured, *Rana septentrionalis* and *Bufo americanus*. We saw nothing of the salamander, *Plethodon glutinosus*, of which Packard speaks, nor did we see that peculiar jumping-mouse, *Zapus hudsonius*, which Mr. Bryant mentions as being so abundant along the Hamilton or Grand River. Any naturalist in search of specimens of the mosquito and black fly will find a most prolific field in Labrador. Such numbers of these pests did we encounter that I have come to look upon Labrador as the fatherland of these torments.

We left Cartwright on September 14th for Pilley's Island, off the Newfoundland coast, and here we caught the steamer Sylvia for New York. We arrived in New York on September 30th, very nearly three months from the date of our start.

CHARLES E. HITE.

MINERALOGY.[1]

Minerals from the Chromite Deposits of Lower Silicia.—Traube[2] describes serpentine, albite, chromite, kämmererite and rutile from the chrome deposits of Tampadel in the Zobtengebirge in lower Silicia. The kämmererite is found to some extent in crystals a centimeter across of greenish, reddish, or violet color, and either in hexagonal plates or in combinations of hexagonal pyramid and base. In transmitted light thin cleavage plates show a division of the field into a central uniaxial portion, and six marginal biaxial areas. The marginal areas have an optical angle of 20°–30° with the plane of the axes parallel to the marginal edge. In the same paper cerussite, Iglesiasite, Tarnowitzite, hemimorphite, pyrrhosiderite and sulphur are described from the upper Silician ore region. The cerussite is interesting because of the wealth of the crystals in forms. A crystal from the Friedrichsgrube showed nine forms including the new form $a=4P$ (441). Another crystal exhibited eighteen forms including the two new forms $f=\infty \breve{P}7$ (170) and $g=7\breve{P}7$ (171). Iglesiasite, the zinc-bearing cerussite, which has been known from but the one locality of Monti Poni near Iglesias in Sardinia, is found on smithsonite in good crystals at Radzionkau. The forms x (012), i (021), y (102), e (101), i (210), m (110), r (130), p. (111), and o (112), were observed and measured, the form $i=\infty \bar{P}2$ (210) being new to cerussite. Chemical analysis showed the mineral to contain 5.47 per cent. $ZnCO_3$, while that from Iglesias contains 7.02 per cent. Tarnowitzite, the isomorphous mixture of calcium and lead carbonates is studied in the original locality of Tarnowitz. The mineral is sometimes clear and colorless, but is also green, reddish-brown, or yellowish. Lead carbonate is present up to 9 per cent in some specimens. All of the four analyses made from specimens differently colored, showed the presence of a small per cent (up to 0.35) of Sr O. A number of brachydomes were observed which have not before been described upon this mineral, viz: (031), (051), (061) and (071).

Artificial Reproduction of Anhydrite from Evaporation of Salt Solutions.—Brauns[3] has produced anhydrite in microscopic

[1]Edited by Dr. Wm. H. Hobbs, University of Wisconsin, Madison, Wis.

[2] Zeitschrift d. deutsch geologischen Gesellschaft, xlvi, pp. 50–67, 1894.

[3] Neues Jahrbuch, f. Min., etc., 1894, (II), pp. 257–264.

crystals by bringing upon an object glass a large drop of a saturated solution of sodium or potassium chloride or a mixture of the two salts, and placing to one side of this a drop of calcium chloride solution, and on the other side a drop of Epsom salt solution. The three drops are joined to one another by narrow paths and evaporated. During the diffusion of the liquids which takes place, calcium sulphate is formed and appears in crystals of both gypsum and anhydrite along with the crystals of the chlorides. When a little water is added to a group of anhydrite crystals they are dissolved to recrystallize as gypsum. By properly regulating the amount of water added, *Knaüel* of gypsum may be formed with a corroded core of anhydrite. Although anhydrite has been frequently produced artificially, none of the methods heretofore used have simulated its production in nature from the evaporation of sea water.

Artificial Crystals of Zinc Oxide.—Ries[4] has examined artificial crystals of zinc oxide from the New Jersey Zinc Works and found them to possess the combinations (110), (225); (110), (112); and (110), (124): the form (124) being new. The crystals examined were colorless, transparent, holohedral, and devoid of basal cleavage.

Artificial Copper Crystals in Aventurine Glass.—Washington[5] has made a microscopical study of the aventurine glass from the famous Murano near Venice. The spangles of copper appear in large and small phenocrysts and in microlites. The large phenocrysts are .05–.12 mm. in diameter, of tabular habit, and not over .002 mm. thick They are generally hexagonal in outline, but some are equilateral triangles with the angles somewhat truncated. Distinct skeleton forms appear among the commoner individuals with plane faces. These crystals are all doubtless octahedra flattened parallel to an octahedral face, a habit which Dana has shown to be common in the case of copper crystals. Some individuals exhibited the distorted combination of cube and octahedron, while others were cyclic twins parallel to an octahedral face and either vierlings or fünflings, the latter producing a closed form.

New Minerals, *Neptunite and Epididymite.*—Flink[6] describes in detail two new minerals associated with ægerine from Greenland. The exact locality is not certainly known, but it is thought to be near

[4] Am. Jour. Sci., xlviii, p. 256, Sept., 1894.
[5] Am. Jour. Sci., xlviii, pp. 411–418, Nov., 1894.
[6] Zeitsch. f. Kryst., xxiii, pp. 344–367, 1894.

Narsisik. *Neptunite* is a black titano-silicate of iron, manganese, soda, and potash, which is found on the surface and in fissures in ægerine crystals, in crystals varying from microscopic dimensions to five centimeters. These crystals, which are monoclinic, exhibit the following forms: (100), (010), (001), (110), $(\bar{3}01)$, $(\bar{2}01)$, $(11\bar{1})$, (221), $(\bar{5}12)$ and $(\bar{1}11)$; the forms (001), (110), and the pyramid $(\bar{5}12)$ predominating. The axial ratio is a : b : c : = 1.31639 : 1 ; 0.8075 and $\beta = 64° \ 22'$. Twinning is very rare with the base the twinning plane. Cleavage is distinct parallel to the prism, the cracks meeting at 80° in sections normal to $\acute{c}$. The specific gravity is 3.234 and the hardness 5–6. The plane of the optical axes is normal to the plane of symmetry and the acute bisectrix makes 18° with the vertical axis in the obtuse angle β. The absorption is $\mathfrak{c}$ deep red brown, $\mathfrak{b}$ yellow red, and $\mathfrak{a}$ bright red, with $\mathfrak{c} > \mathfrak{b} > \mathfrak{a}$. Written empirically the formula of the mineral is $(\frac{2}{3}Fe + \frac{1}{3}Mn)\ (\frac{3}{4}Na^2 + \frac{1}{4}K_2)Si_4\ Ti\ O_{12}$. The interfacial angles never vary more than 10° from the corresponding angles of titanite, which leads Flink to think that neptunite and titanite are isomorphous.

Epididymite is dimorphous with the eudidymite of Brögger, the empirical formula of both minerals being $H\ Na\ Be\ Si_3O_8$. Epididymite is orthorhombic in symmetry, whereas eudidymite is monoclinic. The axial ratio of epididymite is a : b : c = 1.7367 : 1 : 0.9274. The forms observed were (100), (010), (001), (110), (310), (210), (201), (403), (401), (101), (304), (203), and (221). The crystals are columnar parallel to $\bar{b}$, and the cleavage is perfect parallel to the base and less perfect parallel to the macro-pinacoid. H=6. G=2.548. The mineral is colorless. The plane of the optical axes is the base with $\breve{a}$ coincident with $\mathfrak{a}$ the acute bisectrix. The optical angle calculated from measurements of the indices of refraction is $2V_a = 31° \ 4'$. The relation between epididymite and eudidymite would seem to be somewhat similar to that existing between the monoclinic and triclinic feldspars of the same composition.

Other minerals described from the locality are Xatapleite (heretofore found only at Langesund), ægerine, Arfedsonite, quartz, orthoclase, albite, eudialite, zircon, epidote, Zinnwaldite, microlite, and elpidite.

Crossite. Palache[7] has examined the "glaucophane" of some rocks from the Coast Ranges and finds it to differ so much from the known occurrences of glaucophane, that he proposes to call it crossite. The occurrence specially studied is in a boulder from the west slope of the Contra Costa Hills near Berkeley, Cal. Crystals of the mineral show

[7] Bull. Dept. Geol. Univ. of California, i; pp. 181–191, pl. 11, 1894.

the prism and clinal pinacoid, the prism angle being 126° 6′. The axis of greatest elasticity $\mathfrak{a}$ makes an angle of 11°–13° with $\acute{c}$, probably in the obtuse angle. The pleochroism is very strong with $\mathfrak{a}$ sky blue to dark blue, $\mathfrak{b}$ reddish to purplish violet, and $\mathfrak{c}$ yellowish-brown to greenish-yellow. The absorption formula is $\mathfrak{a} \geqq \mathfrak{b} > \mathfrak{c}$. The strea is pale blue. G=3.126–3.16. Below are quoted the analyses of glaucophane (I), Riebeckite (II), and the Berkeley amphibole (III) for comparison:

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total
I.	55.64	15.11	3.08	6.85	.56	7.80	2.40	9.34	——	100.78
II.	50.01	——	28.30	9.87	.63	.34	1.32	8.79	.72	99.98
III.	55.02	4.75	10.91	9.45	trace	9.30	2.38	7.62	.27	99.70

Optically the mineral is almost identical with the amphibole described by Cross from Custer Co., Colorado, and it is closely related to Riebeckite. Chemically it is intermediate between Riebeckite and glaucophane.

Willyamite. Pittman[8] gives the name Willyamite to a sulphantimonide of cobalt and nickel from the Broken Hill mining district of New South Wales, having the formula (NiCo) S (Co Ni) Sb, cobalt and nickel being present in nearly equal amounts.

Kylindrite. Frenzel[9] describes a new mineral from Mina Santa Cruz at Poopó, Bolivia, which is notable as well for its unusual chemical composition as for its crystal form. Analysis furnished the following results:

Pb	Ag	Fe	Sb	Sn	S	Total
35.41	0.62	3.00	8.73	26.37	24.50	98.63

which correspond to the formula $Pb_6Sb_2Sn_2S_2$ or 6PbS, Sb_2S_3 $6SnS_2$, the silver and iron replacing the lead. The mineral receives its name from the remarkable cylindrical rods in which it appears. On grinding these in the mortar they separate into concentric cylindrical shells. A few minute needles which were found in a cavity show the symmetry of the mineral to be orthorhombic. The lustre is metallic, the color dark leaden, and the streak black. H=2.5 and G=5.42. The mineral is soluble in hot hydrochloric and nitric acids, and melts in the closed tube with the separation of sulphur.

Wm. H. Hobbs.

[8] Rec. Geol. Surv., New South Wales, iv, pt. i; pp. 21–22, 1894.

[9] Neues Jahrbuch f. Mineralogie, etc., 1893, II, pp. 125–128.

PETROGRAPHY.[1]

Geology of Angel Island, San Francisco Bay.—Angel Island in San Francisco Bay, Cal., consists essentially of a syncline of sandstone interbedded with an intrusive sheet of fourchite and cut by a serpentine dyke and a second mass of fourchite. A radiolarian chert is associated with the sandstone. The most interesting feature connected with the rocks is the discovery by Ransome[2] that both the fourchite and the serpentine have effected metamorphic changes in the sandstone and in the chert, and that in all cases the resulting product is the same, viz., a glaucophane schist. The serpentine and the fourchite are thus true eruptive rocks, neither being, as supposed by Becker, a metamorphosed sediment. The glaucophane schists are true contact rocks, and are not the result of a general oregional metamorphism of pre-existing rocks. Not only do they occur as contact facies of the sandstones and cherts, but the former rock often contains pebbles of schists, in their essential features similar to the contact schists. The sandstone is made up of quartz, plagioclase and fragments of various rocks. The fourchite consists almost entirely of nearly colorless augite in rounded or irregular grains, and a small quantity of an interstitial substance composed of smaller granules of augite and a fine grained neatrix, which under high powers resolves itself into small, stout colorless crystals imbedded in a yellowish-green substance that is nearly isotropic. The crystals are thought to be zoisite, which may be an alteration product of plagioclase, although the author thinks this origin not probable. Often the augite is changed peripherally into glaucophane, which either replaces the pyroxenes, fills cracks in them, or occurs in the spaces between adjacent grains. A few of the specimens examined possess a glassy groundmass and others are porphyritic. Brecciated and spheroidal facies were also observed. The schist produced by the alteration of the sandstones and cherts is sometimes composed of aggregates of glaucophane in a matrix of colorless albite. Brown mica, garnets and sphene are also present to some extent in the rock. Other varieties of the schist are essentially aggregates of quartz and glaucophane. Occasionally the glaucophane is in falrly well defined crystals, but usually it is in sheaf-like bundles of fine needles. The altered cherts now consist of spherules of cryptocrystalline silica

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Maine.

[2] Bull. Dept. Geol. Univ. of Cal., Vol. 1, p. 193.

or grains of recrystallized quartz and microlites and bundles of nearly colorless augite. The serpentine on the island is nodular as the result of shearing. It was derived in all probability from a rock made up almost exclusively of diallage. It contains granules of chromite. This serpentine has effected the same alterations in the chert and sandstone through which it cuts, as has the fourchite. Some peculiar inclusions of a dark rock in the serpentine are supposed to be the remnants of a dyke that formerly occupied the fissure, which the serpentine subsequently filled. These fragments now consist of a holocrystalline aggregate of augite and albite, of which the first mineral is sometimes altered to green and brown hornblende. Analyses of the fourchite (I) and of a fresh nodule of serpentine (II) follow:

	SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O	P_2O_5	Loss	Total
I.	46.98	17.07	1.85	7.02	12.15	8.29	.53	2.54	.09	4.86	=101.38
II.	42.06	2.72		2.88		39.53	not estimated			12.04	= 99.23

A New Rock-Volcanite.—In an abstract of a paper to appear in a German periodical, Hobbs[3] gives an account of an anorthoclase-augite rock which he calls volcanite. It occurs as bombs projected from Volcano in 1888–89. Phenocrysts of anorthoclase, andesine, an acmitic augite and olivine are imbedded in a groundmass containing two generations of the first named of these minerals in a glassy base. The augite phenocrysts in many instances have been resorbed by the rock's magma and have thus given rise to pseudomorphs of colorless pyroxene, magnetite, and plagioclase. The structure of the rock is trachytic. Its chemical composition corresponds with that of the dacites, while its mineralogical composition is that of an augite pantellerite. Analyses of the anorthoclase (II) and of the rock mass (I) follow:

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	Na_2O	K_2O	H_2O	P_2O_5	Total
I.	66.99	17.56	1.41	3.39	tr	4.25	.93	3.35	.34	1.53	tr	=99.75
II.	60.01	20.12	2.82			5.15	.23	6.43	3.67	.77		=99.20

Acmite Trachytes from Montana.—Among the eruptive rocks occurring as dykes, sheets and laccolitic masses in the Cretaceous of the Crazy Mts. are acmite trachytes and eleolite syenites. The former, according to Wolff,[4] is present in small sheets and dykes and in

[3] Bull. Geol. Soc. Amer., Vol. 5, p. 598.

[4] Bull. Mus. Comp. Zool., xvi, p. 227.

apophyses from laccolitic masses. It is a rock made up of phenocrysts of anorthoclase, sodalite and augite in a groundmass of lath-shaped feldspars and acicular aegirines and acmites imbedded in a colorless interstitial matter, composed in all probability of nepheline and analcite. The augite phenocrysts are provided with an outer zone of aegerine. Needles of this mineral are included in all the colorless constituents. The eleolite syenite is from the laccolites. It is panidiomorphic, with fresh onorthoclase phenocrysts in a fine grained mass of feldspar, augite, aegerine, acmite, the angular spaces between which are occupied by nepheline. Analyses of the syenite and of one variety of the trachyte gave:

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	Na_2O	K_2O	TiO_2	P_2O_5	Ign.	Loss	Total
59.66	16.97	3.18	1.15	.19	2.32	.80	8.38	4.17	tr	.14	2.53	.07	99.56
62.17	18.58	2.15	1.05	tr	1.57	.73	7.56	3.88	tr	.11	1.63	.07	99.50

Petrographical Notes.—In a glassy rock from near Harrismith, in the Orange Free States, Molengraff[5] finds small crystals of twinned cordierite, little octahedra of magnetite and skeleton crystals of augite. The cordierite is slightly pleochroic. Its crystals are well defined and possess all the peculiarities of the mineral. An analysis of the rock shows:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3 FeO	MgO	CaO	K_2O	Na_2O	Loss	Total
64.54	.79	19.16	7.23	3.39	2.47	.57	1.13	2.25	=101.53

The large percentage of SiO_2 present as compared with the small percentages of the alkalies suggests to the author that the rock is an abnormal type. After a critical discussion of the literature of cordierite as a rock component, the conclusion is reached that, in all probability, the specimens studied represent foreign inclusions fused in a basic rock.

A very brief account of the lavas and ashes of the old volcano Rhobell Fawr near Dolgelley in Wales, is given us by Cole.[6] The greater portion of the products are ashes containing hornblende and augite. The lavas are augite, aphanites and basaltic and andesitic andesites.

[5] Neues Jarb. f. Min. etc., 1894, I, p. 79.

[6] Geol. Magazine, x, 1893, p. 337.

Rutley[7] gives a few illustrations in proof of his statement that the production of spherulites is sometimes a devitrification process subsequent in point of time to the development of perlitic cracks in the volcanic rocks in which they occur.

In a recent number of Science Blake[8] suggests the notion that many of the quartz veins, 'reefs' and boss-like masses in ancient rocks are the result of deposition from old thermal springs.

The rock of Saint Sardoux, Puy-de-Dame, France, is composed[9] of ilmenite and soda-augite in a groundmass consisting largely of nepheline crystals cemented by a matrix of feldspar and glass. Sometimes the augite and nepheline are intergrown like the constituents of a pegmatite and at other times they form an ophitic aggregate, with the nepheline the older component. The rock penetrates the peperites of the region in the form of dykes and veins.

New Books.—Granites and Greenstones[10] is the title of a new series of tables for the determination of rocks and their essential components. The author, Mr. Rutley, divides rocks into Volcanic rocks, Dykes and Sills and Plutonic masses, and then subdivides each group into four series as follows: Ultra-basic with SiO_2=39–45 per cent; basic, with silica 45–55 per cent, intermediate, with SiO_2=55–66 per cent; and acid, with silica over 66 per cent. The ultra-basic series is divided into the non-feldspathic and the potentially feldspathic, including nepheline and leucite non-feldspathic rocks. The basic rocks are all plagioclastic. They include a nephelinic or leucitic and a non-nephelinic group. In the dyke and sill division of this series are included the diabases. In the intermediate series we find again two groups—the orthoclastic and the plagioclastic, and in each of these nepheline and non-nepheline sub-groups. The acid series includes a division whose feldspars are plagioclase or anorthoclase, and one in which the feldspar is orthoclase. Definitions and notes are abundant and are so given as to really explain the tables. The elvans are described as the apophyses of deep seated granitic masses. They include micro-granites, aplites, quartz-porphyries and greisens. The mineralogy tables contain no startling novelties. They are good and the book itself is well worth study. It will serve as a useful companion to the student.

[7] Quart. Jour. Geol. Soc., Feb. 1894, p. 10.

[8] Science, Vol. xxiii, 1894, p. 141.

[9] Bull. Soc. Franc. d. Min. xvii, p. 43.

[10] Granites and Greenstones, a series of Tables and Notes for Students of Petrology. By Frank Rutley. London, Thos. Murby, 1894, pp. 48.

In an article of 52 pages on the optical recognition and economic importance of the common minerals found in building stones, Luquer[11] mentions the principal microscopic characteristics of the most important minerals with sufficient fullness to enable the technical student to determine them in the thin section. He also notes the effect of presence of each upon the value of the various building stones in which they occur. He, moreover, describes the usual associates of each different mineral, and so incidentally gives the composition of the principal rocks used in constructions. The article in pamphlet form is simple and useful.

[11] School of Mines Quart. xv, p. 285–336.

GEOLOGY.

Meunier on Meteorites.—The collection of meteorites in the Natural History Museum of Paris is unexcelled to-day in respect to variety and quantity of material amassed. To this series of natural meteorites has been added the products of experimental syntheses resulting from attempts to solve the problem of the origin of meteorites. Further facility in the study of this extramundane material is afforded by bringing together the meteoric minerals and types of analogous earth minerals for the purpose of comparison. It has been thought possible by M. Stanislas Meunier to arrive at some definite conclusion as to the origin and possibly the past history of meteorites by a close study of their composition and a comparison of their mineral constituents with similar minerals occurring in our own earth formations. Such a study, embracing as it does both geological and astronomical facts, he calls comparative geology.

M. Meunier takes for a starting-point the meteorites of Chili, which, for convenience, are classified under special types. Each type is described in detail, its particular lithological characters discussed, and their significance given. In the course of the examination M. Meunier finds true breccias, metamorphic rocks and volcanic rocks so similar to terrestrial eruptions that the closest attention is necessary to detect the difference. The conclusion from these facts is that the original source of these meteors has been the theatre of geological phenomena comparable with those occurring on the earth.

M. Meunier does not hold with the theory that meteors and shooting-stars have a common origin. The chief objections to the theory are: (1) Shooting-stars are never accompanied by noise; meteors always are. (2) Shooting-stars are periodical in appearance; meteors are irregular. He is of the opinion that meteors are fragments of a single star which was constructed on the same general plan as our planet, and notes that it is possible that the fragmentary stage is the last phase of a true sidereal evolution. (*Actes Soc. Scien. du Chili, Tome III.*)

The Origin of Bitumens.—In a recent number of the *American Journal of Science*, S. F. Peckham gives a short account of how he was led to adopt Newberry's "distillation" theory to account for the origin of bitumens. The heat required for distillation results from metamorphic action. In regard to the oils of eastern Ohio and western Pennsyl-

vania, the agent for their production was found in the gradual dying out of the heated area which involved the Appalachian system. Beginning at the Palisades and following a northwesterly line, Mr. Peckham notes the following facts in proof of his theory: Through eastern Pennsylvania the coal is metaphosed into anthracite. At St. Mary's, on the summit of the Alleghanies, the coal is semi-anthracite. In the most easterly county of Pennsylvania in which petroleum is obtained, McKean, the petroleum occurs at a depth of two thousand feet, under a pressure estimated at four thousand pounds to the square inch, and filled with paraffine, just as it ought to be if produced by metamorphism. Further west the petroleum becomes lighter. The products of distillation are present in proper sequence along the entire line from Point Gaspè to Lookout Mountain, and the porous sand-bars and pebbly ripples formed by the currents of the primeval ocean are not filled with the oil, because they afford a receptacle adequate to receive and store the vast accumulations of distillate. (*Amer. Jour. Sci.*, Dec., 1894.)

Changes in Ore Deposits.—The chemical and physical changes that take place in ore deposits exposed to surface influences has been made the subject of study by Mr. R. A. F. Penrose, Jr., and the results of his investigations embodied in the following summary:

The process of alteration is primarily one of oxidation, and generally of hydration, and both of these actions may go on alone, but generally both have their effect upon the same material. The action of surface influences is in rare cases one of reduction. The process of alteration frequently causes leaching of certain ingredients of the ore deposit. A worthless material may be made valuable by the introduction of a new constituent, as in the replacement of a carbonate of lime by a phosphate of lime. Deposits are sometimes concentrated by capillary action in soils.

The physical effect of superficial alteration is to make the deposit more open and porous, and to cause it to shrink. If, however, hydration is active, expansion may be caused.

The depth of alteration varies from a fraction of a foot to 1500 feet, and possibly more.

The accumulation of soluble saline materials on the surface has an important effect in converting certain materials in underlying ore deposits to chlorides, etc. This explains the abundance of haloid compounds in ore deposits of the arid regions of the western part of North America, and in certain parts of Chili and Peru. (*Jour. Geol.*, Vol. II, 1894.)

Dean on Coprolites.—In the description of a new Cladodont shark, *C. newberryi*, from the Ohio Waverly, Mr. Bashford Dean refers to a coprolite found with the specimen, as follows:

"It (the coprolite) is especially interesting, since it furnishes a cast of the intestinal wall, and gives definite evidence as to the presence of a spiral valve. This structure accordingly maintained in the generalized Cladodont, and that the intestinal septa were here low and numerous is most significant phylogenetically. Its condition in this form, as the nearest known ancestor of Selachians, would, moreover, give an additional reason for emphasizing the most ancient origin of Dipnoan, Teleostome, and even Chimæroid."

This discovery of Dr. Dean throws a light upon certain screw-like fossils described under the names Spiraxis, Spirangium, etc. Newberry's descriptions and figures of *Spiraxis major* and *S. randallii*, from the Chemung sandstone, are identical with the coprolite figured by Dr. Dean from the intestine of the shark. The inference, then, is that many of these screw-like forms from geological horizons, in which sharks are numerous, and which have been referred by different investigators to Algæ, are in reality coprolites. (*Trans. N. Y. Acad. Sci.*, Vol. XIII, 1894.)

New Molluscan Forms from the Dakota Formation.—So little is known of the fauna of the Dakota formation that great interest is attached to the discovery by Dr. Hicks of some invertebrate remains in Jefferson County, Nebraska. The Dakota strata in this locality consist of ferruginous limestone, the fossiliferous layers being impure limonite. The fossils are all either vegetal or molluscan, and are in the condition of natural casts, molds or imprints. The mollusca were referred for identification to Dr. Charles A. White, who describes and figures them in the Proceedings of the National Museum. The collection comprises five new species and two doubtful ones, all indicating unmistakably, in the author's opinion, a purely fresh-water fauna.

In his concluding remarks, Dr. White refers to the unusual interest attached to these new forms by reason of the following facts:

"It is one of only three collections of invertebrate remains from the Dakota formation. It indicates, more distinctly than any previously discovered facts have done, the nonmarine character of that formation. It embraces four genera which have never before been recognized in collections from its strata. Lastly, although this formation lies at the base of the Upper Cretaceous series, a majority of the species which this collection contains belong to genera representatives

of which are among the characteristic members of the molluscan fauna now living in the waters of the Mississippi drainage system. (*Proceeds. U. S. Natl. Mus.*, Vol. XVII, 1894.)

Glacial Lakes in Western New York.—This subject is treated in two papers which describe briefly the glacial lacustrine history of Western New York, introductory to fuller treatment hereafter. The author shows, with the aid of specially prepared maps, how the remarkable valleys of the "finger lakes" terminate abruptly at their southern ends in the high land which forms the divide between the St. Lawrence and the Susquehanna—Ohio waters. The deep preglacial valleys, cut to some unknown depth through the divide, have been partly filled with frontal moraine drift-making cols, which were the waste-weirs for the glacial waters.

As the ice-sheet slowly retreated northward, it was a barrier to the waters which were poured in the south ends of these deep valleys and forced to overflow into the Susquehanna. In all the valleys a well-marked abandoned stream channel is found south of the col, while north of the col are found the delta deposits of the streams which emptied into the glacial lakes at their maximum and later levels.

The author described with some detail several of those local glacial lakes, among which were the Watkins (glacial Seneca) Lake, which at its maximum was about thirty miles long, some four to eight miles wide and one thousand feet deep. The Ithaca (glacial Cayuga) was even larger and deeper than the Watkins Lake. The deltas and shore inscriptions of all the glacial lakes are well marked, and in this lies proof of the power of ice to act as barrier to deep water.

Glacial lakes also occupied valleys in which to-day there are no lakes, but free northward-flowing streams, as the Tonawanda, Canaseraga, Genesee, Onondaga and others. Professor Fairchild named eighteen of the local glacial lakes from Attica on the west to Tully Valley on the east.

As the ice-lobe damming each of the several glacial lakes melted, the waters were lowered into the level of the great water body which buried all of Western New York north of the divide and most of the area of the Great Lakes. At first this water had its outlet at Chicago, and has been named by Mr. Spencer, Lake Warren. But when the ice by its retreat finally uncovered the Seneca Valley, the outlet of the Watkins Lake at Horseheads became, owing to the depression of the "Finger" lakes region, the outlet of the Continental lake, and this remained the outlet until the ice, by its further retreat, uncovered the

Mohawk Valley and differentiated the waters, the lake then covering the Ontario depression, being known as Lake Iroquois. For the lake having its outlet at Horseheads, and lying both in geographical horizon and in time between lakes Warren and Iroquois, Professor Fairchild proposed the name Lake Newberry. —H. L. FAIRCHILD.

Geological News, General.—An excellent geological map of Alabama has just been issued by the Geological Survey of that State. For the exact determination of the limits of the geological formations as shown in the map, its chief responsibility and credit are as follows: Formations of the coastal plain, Smith, Langdon and Johnson; coal measures, McCalley, Squire and Gibson; other Paleozoic formations, McCalley, Gibson and Hayes; crystalline rocks, Smith, Phillips and McCalley. The colors chosen are distinct, so that the different horizons are well defined. An explanatory chart accompanies the text.

According to F. Leslie Ransome, Angel Island, in San Francisco Bay, affords an example of a pronounced contact metamorphism effected by the rock of which serpentine is a derivative, and by the fourchite, upon cherts and sandstones through which they have forced their way. The resulting rocks consist almost wholly of holocrystalline schists, which present no essential differences when derived from sandstone from those formed by the metamorphism of the chert; also, the schist produced by contact metamorphism alongside the serpentine has no distinct feature differentiating it from that adjacent to the fourchite. This leads to the generalization that the attempt to assign all of the glaucophene schists of the coast ranges to a general regional metamorphism must be abandoned. (*Bull. Dept. Geol. Cal. University.*, Vol. I, 1894.)

Archean.—The so-called Lower Laurentian rocks, near St. John, N. B., are found by W. D. Matthew to consist in large part of intrusives of two types, Granite-diorite and Olivine-gabbaro. The age of the first of these is later than the Upper Laurentian limestone, and may be Devonian, but is probably pre-Cambrian. The age of the gabbro is not given. (*Trans. N. Y. Acad. Sci.*, Vol. XIII, 1894.)

Paleozoic.—The fossils from the Trenton limestones of New York, referred by Prof. Hall to the Graptolitidæ under the names of *Buthograptus laxus* and *Oldhamia fruticosa*, are shown by Prof. Whitfield to be true marine Algæ of the articulate type. The form of the Buthograptus when living was probably plumose, with a cylindrical

axis, from which a series of pinnules arose on two opposite sides, not quite opposite to each other at their origin, but slightly alternating. These pinnules were probably cylindrical, somewhat club-shaped, and attached to the axis by the knob-like inner end. Since the name *Buthograptus* is misleading, the author suggests *Bythocladus* as more appropriate. Of the so-called Oldhamia, Prof. Whitfield has found three forms which he describes and figures in the *Bull. Amer. Mus. Nat. Hist.*, Vol. VI, 1894.

A new fossil fish, *Psammosteus taylorii*, from the Upper Old Red Sandstone of Morayshire, Scotland, is reported by Dr. Traquair. The new species is based on detached plates thick and smooth internally, and as to contour are gently hollowed in boat-like fashion. The microscopic structure of the remains suggests that they were Selachian in their nature. (*Ann. Scottish Nat. Hist.*, 1894.)

Bulletin No. 4 of the Illinois State Museum of Natural History contains descriptions by Miller and Gurley of thirteen new Crinoids from the Upper Devonian and Niagara of Indiana, Kentucky and Illinois. Three plates accompany the descriptions.

Mr. E. O. Hovey regards the Lower Magnesian and Lower Carboniferous cherts of southern Missouri due to chemical precipitation at the time of the deposition of the strata in which they occur or before their consolidation. (*Amer. Jour. Sci.*, 1894.)

Mesozoic.—The study of new material by Prof. Seeley confirms Huxley's conclusions concerning *Euskelesaurus brownii*, a fossil Dinosaurian from South Africa. The jaw is formed on the type of Megalosaurus, but the pubis resembles that of Massospondylus. Prof. Seeley places it in the Saurischia in near association with the latter genus and Zanclodon, though with a near approximation to Megalosaurus. The evidences for these conclusions are given in the account to the several bones. (*Amer. Mag. Nat. Hist.*, Nov., 1894.)

M. H. E. Sauvage calls attention to some reptiles found in the upper part of the Jurassic beds of Boulonnais. A list of the species determined by the author comprises four Ichthyopteryians, eleven Sauropterygians, one Pterodactyle, four Dinosaurians, eight Crocodiles and seven Chelonians. (*Revue Scientifique*, Dec., 1894.)

According to Capt. H. G. Lyons, the Nubian sandstone of Egypt and Nubia is of Cretaceous age, and is probably an estuarine deposit. In the Lybian Desert this sandstone forms an immense table-land, weathered into flat-topped masses and truncated pyramids, witnesses of the amount of erosion that has taken place. Upper Cretaceous rocks

overlie the sandstone near Esna, and are exposed over a large area forming the floors of the oases of Kharga, Dakhla and Tarafra. (*Quar. Jour. Geol. Soc.*, Nov., 1894.)

Cenozoic.—Mr. Barbour presents some additional notes on the new fossil, Dæmonelix, from the Pine Ridge table-lands in Nebraska. Further examination of the locality in which the fossil occurs shows that the whole deposit is undoubtedly aqueous in origin, and the author gives his reasons for believing the fossils to be contemporaneous with the sediment. A singular fact revealed by the microscope is that every section, no matter from what specimen or from what portion of each individual specimen the section is made, shows perfectly definite and unmistakable plant-structure. (*Univ. Studies*, Vol. II, 1894.)

A fine specimen of *Cervus* (*Eurycerus*) *hibernina* Owen belonging to Dr. Krantz Museum affords Dr. Pohlig an opportunity for studying the relation of this species to others of the same group. He shows that the deer (*Cervus dama*), and not the elk (*C. alces*), is the nearest ally of Eurycerus, and that these two species are closely united by transitional forms in both types. Dr. Pohlig bases these relations between the different species of the Cervidæ upon the development of the antlers. (*Bull. Soc. Belge de Geol., Tome VIII*, 1894.)

Numerous small displacements produced since the glacial period in the rocks about St. John, N. B., are noticed by G. F. Matthew. The faults vary from one-quarter of an inch to five inches, and in almost every case the downthrow was on the north side, and the leade of the fault was to the southwest. (*Amer. Jour. Sci.*, Dec., 1894.)

BOTANY.[1]

The Systematic Botany of North America.—Under this title a work of great importance to science is now in preparation for early publication. Following the suggestion of Rabenhorst's "Kryptogamen Flora," and Engler and Prantl's "Natürliche Pflanzenfamilien," the originators of the project have sought to bring to their aid as many as possible of the working botanists of North America. Accordingly we find the names of Professor G. F. Atkinson, of Cornell; Professor N. L. Britton, of Columbia; President J. M. Coulter, of Lake Forest; Chief Botanist F. V. Coville, of the National Herbarium; Professor E. L. Greene, of California; Professor B. D. Halsted, of Rutgers, and Professor L. M. Underwood, of De Pauw, upon the board of editors, with such as the following in the list of those who have assured the editors of their coöperation: Professor T. C. Porter, of Lafayette; Professor C. R. Barnes, of Wisconsin; Director Wm. Trelease, of the Missouri Botanical Garden; Professor L. H. Bailey, of Cornell; Professor C. S. Sargent, of Harvard; Professor T. J. Burrill, of Illinois, and many others equally well known.

In the mode of publication the German plan will be followed also, the work to appear in parts of about one hundred pages each, published at intervals, five of these parts usually constituting a volume. The sequence will be that of Engler and Prantl's "Natürliche Pflanzenfamilien," and will include all plants from the Protophyta to the Compositæ. It is estimated that it will require about seventeen volumes for the whole work, or about eighty-five parts, and that it will take fifteen years to complete it. According to the present plan, Volume I will contain the *Myxomycetes, Schizomycetes, Cyanophyceæ* and *Diatomaceæ;* Volume II, the algæ; Volumes III to VIII, the fungi; (Vol. IV, the lichens); Volume IX, the *Bryophyta, Pteridophyta* and *Gymnospermæ;* Volumes X and XI, the Monocotyledons; Volumes XII to XVII, the Dicotyledons.

It is announced that the following parts are to appear during 1895: *Pyrenomycetes* (two parts), by J. B. Ellis and B. M. Everhart; *Hepaticæ,* by L. M. Underwood; *Typhaceæ, Sparganiaceæ, Naiadaceæ, Juncaginaceæ, Alismaceæ* and *Hydrocharitaceæ,* by Thomas Morong; *Cyperaceæ* (two parts), by N. L. Britton and L. H. Bailey.

The parts may be obtained as issued of Professor N. L. Britton, of Columbia College, New York, the chairman of the board of editors.

Charles E. Bessey.

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

Botanical News.—Botanists everywhere will be glad to learn that the veteran collector, A. H. Curtiss, of Jacksonville, Florida, has resumed the collection and distribution of herbarium specimens. All who have seen the fine specimens which Mr. Curtiss prepared in his sets of North American plants distributed ten or more years ago need not be told of their superior quality. He now offers in this "Second Distribution of Plants of the Southern United States" two "series" of two hundred species each, at sixteen dollars per series. It is to be hoped that this distribution will be given the encouragement it deserves.

The experiment of publishing monthly the cards for the card-index to the Bibliography of American Botany has been most successful so far as the work itself is concerned. The printing has been excellent, and a very good quality of card has been used. We trust that botanists who have not already done so will enter their subscriptions soon for this most useful help in the botanical library. The annual subscription is five dollars, and the cards are supplied by the Cambridge Botanical Supply Company, Cambridge, Mass.

Among the excellent text-books of botany which have recently appeared in Germany, two deserve especial mention, viz.: Dr. K. Giesenhagen's *Lehrbuch der Botanik,* a pretty volume of 335 octavo pages, from the publishing house of E. Wolf, of Munich, and Dr. K. Schumann's *Lehrbuch der Systematischen Botanik,* of 705 octavo pages, published by F. Enke, of Stuttgart. Both are freely illustrated with good engravings. They will be helpful to those engaged in teaching botany in colleges and universities.

Oels's *Experimental Plant Physiology,* as translated by D. T. MacDougal, of the University of Minnesota, is a most useful little book. A somewhat extended trial with students in physiological botany shows it to be well adapted for laboratory use.

We would like to commend to the botanists of this country, especially to those who are engaged in teaching in the better class of colleges and universities, that most excellent journal, *Garden and Forest,* edited by Professor Charles S. Sargent, of Harvard University. Coming as it does every week, it brings fresh matter to the reader at frequent intervals, and there is not a number in the whole year which does not contain much botanical matter.

Our three strictly botanical journals, *The Bulletin of the Torrey Botanical Club* (now entering its twenty-second volume), *The Botanical Gazette* (entering its twentieth year), and *Erythea* (in its third year), have continued their steady w ays the past year, in spite of

panics and general business depression. They are journals of which American science has no cause to be ashamed. The two older journals include the record of a period of remarkable activity in American botany, and it is fair to say that from them has largely come the impulse to this activity. We doubt not that a score of years hence we may say the same for the much younger journal upon the Pacific coast.

Professor A. S. Hitchcock brought out two handy little books during the past year, viz., *A Key to the Spring Flora of Manhattan* (Kansas), and *A Key to the Genera of Manhattan Plants Based on Fruit Characters.* They are full of suggestions to teachers, and must be very helpful to students of botany in Eastern Kansas. The sequence of families is that of Engler and Prantl.

Professor L. H. Bailey brought out in the August bulletin of the Cornell University Agricultural Experimental Station another of his numerous contributions to botany. This one is devoted to *The Cultivated Poplars,* and with the illustrations and descriptions of the leaves, twigs and buds, must prove useful to those who wish to distinguish the cultivated species of this interesting genus.

From the Bulletin of the Michigan Fish Commission (No. 2) we have "The Plants of Lake St. Clair," by A. J. Pieters, containing eleven pages of text and a map. Lists of aquatic plants are given, and these are accompanied by a discussion of their distribution at different depths and under varying conditions. —C. E. B.

ZOOLOGY.

The Influence of changed Environment on Mollusca.—The experiments made by Professor Semper with specimens of snails in order to ascertain the causes of dwarfing have recently been repeated by M. H. de Varigny who arrives at somewhat different conclusions from those of Prof. Semper. The experiments consisted in isolating young individuals from the same mass of ova in vessels containing different amounts of water, but placed under the same conditions of food, temperature and light. It was found that the size of the individual varies with the volume of water, and Dr. Semper's conclusion is that there is present some substance, as yet unknown, was necessary to the growth of the snail. M. de Varigny observed that while the size does vary with the volume of water, the dimensions vary more with amount of water surface than with volume alone, and increase in size persists when the superfices was increased while the volume was diminished. M. de Varigny suggests that dwarfing is due to lack of room in which to move about. (Journ. del 'Anatomie et de la Physiologie, 1894.)

The genus Leptophidium.—In 1863 I established the genus Leptophidium for ophidiids having a slender form and regularly embricated scales. Having had occasion recently to refer to Hallowell's "Report upon the Reptilia of the North Pacific Exploring Expedition" (Proc. Acad. Nat. Sc. Phila., 1860) I found that he had used the same name previously for a genus of snakes. After endeavoring in vain to identify Dr. Hallowell's genus, I asked Dr. Stejneger and he informed me that he had also vainly attempted to identify the same snake and that no specimens answering to Hallowell's diagnosis were in the National Museum. Prof. Cope has not mentioned the name as that of a valid genus or as a synonym in his Catalogue of Genera of Snakes. (Bull. U. S. Nat. Mus., no. 32, 1887).

But, whatever, may be ascertained to be the value of Hallowell's genus, there is no doubt that *Leptophidium* cannot be retained as the name of the Ophidioid genus. *Lepophidium* (scale, and *Ophidium*) may be given as a substitute and to recall the regular squamation characteristic of the genus.

Lepophidium has proved to be one of great interest and to be represented by a number of species in moderately deep seas. In addition to (1) *L. profundorum* and (2) *L. brevibarbe*, the following were described

by Jordan and Bollman (1889) and Goode and Bean. (Proc. U. S. Nat. Mus., 1890, pp. 108–110).

3. Lepophidium prorates.
4. Lepophidium pardale, 29 fathoms.
5. Lepophidium microlepis, 76 fathoms.
6. Lepophidium stigmatistium, 112 fathoms.
7. Lepophidium emmelas, 306–362 fathoms.

It will be for the future to determine whether these species are characteristic of different horizons or whether they inhabit indifferently various depths.

THEO. GILL.

The Habitat of the Salamander Linguelapsus annulatus Cope.—A single specimen only of unknown habitat has hitherto represented this species in the U. S. National Museum. It is, therefore, of interest that we are able to describe a second specimen as identified by Dr. L. Stejneger from Hot Springs, Arkansas. The specimen is 165 mm. in total length with a comparatively long tail as compared with any of the Amblystomæ we have seen. The specimen is still in Dr. Stejneger's hands, so we cannot give an exact description of it, but we observed the following facts with regard to it as compared with the description of the type in your "Batrachia of North America." The general color was brown above, crossed by narrow bands of gray, and paler below, the first gray band was between the orbits, the second on the occiput, the third on the shoulders; between the shoulder and rump there were one or two less bands than in the type, those on the tail we did not count, two of the bands on the tail united on one side forming a loop.

The head seemed small and the body bulky compared with any other salamanders we have seen. The fore and hind limbs when appressed to the sides were separated by 3 and parts of 2 other costal interspaces as in the type. Taken at Hot Springs, Ark., Nov. 1, 1894.

—H. H. & C. S. BRIMLEY.

The White Headed Eagle in Northern Ohio.—The White Headed Eagle is a resident bird on the peninsula that bounds Sandusky Bay on the north. For more than fifty years there has been a nest on the farm now owned by Mrs. Lammers, about half a mile north of the Danbury Post-Office. The present one has stood only nine years but it was made from the material of another belonging to the same pair

of birds and removed by them to the tree it now occupies after the one which held their old nest had been blown down. Both birds rarely if ever leave their nest at the same time in the course of the whole year. While one goes to the bay for fish the other remains at the nest or at least in the same small piece of woods awaiting the return of her mate or sometimes starting out when she sees him coming. No wonder they feel some solicitude for the home where they have reared so many broods of young and where their abode has been winter and summer for so many years. Occasionally they are visited by a third whom we may suppose to be one of their grown up children returning after long absence to his parents for advice. At any rate he is so well received that he is apt to stay several months.

At this nest two new eaglets, or sometimes only one, are reared each year, but they wander far away from home before they are old enough to find mates and start a new family, for these are only one or two new nests within many miles around. There is another old one about three miles east of this, not far from Piccolo station; another between Port Clinton and Peachton, and one 26 or 27 years old on Kelly's Island. There is also one nest on Put-in-Bay, one on Middle Bass, on North Bass and on Sugar Island. So far as I can learn all the nests are believed by the people that live near them to have been occupied continuously by the same pair of birds for many years. At each nest one bird remains while the other goes in search of food. The pair on Kelly's Island commenced a new nest, near their old one, about two years ago, and have worked on it a number of times since, but have not yet used it. They are supposed to be getting ready to move, on account of the tree containing the old nest being dead. Most of the nests are about 50 feet from the ground and appear to be five or six feet high and four or five across. The birds raise only one brood a year, and rarely, if ever, more than two in a brood, but these two they usually succeed in bringing up, and as eagles are rarely killed in this region, many that are raised here must go elsewhere to live. Quite likely they go farther north, yet it would seem as if the American Eagle were disinclined to make a permanent home beyond the limits of the republic that has adopted it. Perhaps the freezing of the Canadian streams and lakes from which they draw their supply of fish in mild weather drives them south to the Great Lakes. At any rate there are many more eagles on the peninsula in winter than in summer. Two years ago more than fifty were seen at one time on the ice covering what

is called the west harbor, and about seventy-five on the east harbor, feeding on the fish offal thrown away by the fishermen. As the majority of these winter visitors lack the white on head and tail that characterizes the old birds it may be that they are birds that have not mated or built nests.

The eagles at all times of the year subsist on fish, eating but little else. They take them alive from the water and dead from the shore, and here as well as on the Atlantic coast they occasionally take them from the osprey. When an eagle captures a live fish it is sometimes pursued by another eagle which succeeds after a spirited struggle in getting it away. Among the farmers they are not considered beneficial nor very harmful, though they occasionally take tame ducks and, it is said, lambs. On Kelly's Island and Put-in-Bay they are less numerous than formerly, but on the peninsula the number is increasing.

—E. L. Moseley.

The Paludicolæ.—Dr. Shufeldt offers the following scheme to show the divisions of the suborder, Paludicolæ, of the United States :

Suborder.	Superfamilies.	Families.	Genera.
Paludicolae	Gruoidea	Gruidae,	Grus.
		Aramidae,	Aramus.
	Ralloidae	Rallidae	Rallus.
			Crex.
			Porzana.
			Ionornis.
			Gallinula.
			Fulica.

In regard to the connection of the Paludicolae with other avain groups, the author notes that the Jacanidae link this suborder with the Limicolae, through certain species in the Plover-Sandpiper line; Podica and Heliornis lead towards the Pygopodes; and such ancestral types as Chionis connect them with the Longipennes; by various links they are connected also with the Herodiones, through Rhinochetus and Eurypyga.

Professor Fürbringer believes that the Apteryges are far more closely related to the Rallidae than has been, heretofore, realized. If this be true, it forms a line toward the Struthious types—with all the Gallinae likewise only a little more remotely related. (Proceeds. Zool. Soc. London, March, 1894.)

Mexican Glires.—In studying the series of Mexican Rodents collected by Mr. E. W. Nelson, Dr. C. H. Merriam finds that a wood rat described by him sometime ago under the name *Neotoma alleni* represents a new genus for which he proposes the name Hodomys. This genus is characterized by having the crown of the last molar shaped like the letter S, and also by important cranial distinctions.

Associated with Hodomys, by reason of dental characters are Ptyssophorus, Tretomys (both fossil) Xenomys and Neotoma. These five genera form a group presenting, according to Dr. Merriam, nearly every important step in the evolution of the modern genus Neotoma from the Cricetine series, Ptyssophorus is the more primitive type; Tretomys and Hodomys seem to represent more advanced stages in the evolution of the group, while Xenomys and Neotoma are more specialized.

The five genera above enumerated are classed together by the author, as a subfamily, the Neotominae, and it seems to be an independent offshoot, as is also the Arvicolinae, from the half-tuberculate crowned Cricetinae.

Dr. Merriam redefines the genera Ptyssophorus and Tretomys, and characterizes the new genus Hodomys with reference to the more specialized genera Xenomys and Neotoma, and adds descriptions of all the known species. (Proceeds. Phila. Acad. Nat. Sci., Sept., 1894.)

Zoological News,—Spongiæ.—In a paper on the anatomy and relationships of *Lelapia australis*, Mr. Arthur Dendy calls attention to the peculiar reticulated fibrous character of the skeleton, which has previously escaped notice. This character is unknown in any other living calcareous sponge, while it forms a prominent feature in the fossil group Pharetrones of Zittel. The author accordingly regards *Lelapia australis* as a living representative of Pharetrones which family must now be classed with recent Calcarea. (Quart. Journ. Micros. Sci. June, 1894.)

Pisces.—A new species of Ribbon Fish, *Trachypterus rex-salmonorum* is described and figured by Dr. Jordan and Prof. Gilbert. According to the authors, this species bears some resemblance to *L. altivelis* described by Kner from Valparaiso. The latter species has, however, the nuchal crest much lower and farther back, the first dorsal and the ventrals much lower, the second dorsal fin higher, the skin rougher, the four black spots different in size and position from those found in *T. rex-salmonorum*, and the caudal rays divided near the base.

The type of the new species was obtained in the open sea outside the bay of San Francisco. (Proceeds. Cal. Acad. Sci. Ser. 2, Vol. IV, 1894.)

Reptilia.—In the Proceedings of the Rochester Academy of Sciences Vol. II, 1892 is published a paper, by F. W. Warner, on the Ophidians of the Southern States which contains numerous inaccuracies, and which should have been excluded or corrected by the editors of that volume.

Aves.—In a paper entitled "The Origin of certain North American Birds as Determined by their Routes of Migration," Dr. Chapman points out that the Bobolinks which nest west of the Rocky Mts. do not migrate southward with the birds of the Western Province, but retrace their steps and leave the United States by way of Florida, thus furnishing evidence of gradual extension of range westward and of the stability of routes of migration. (Abstr. Proceeds. Linn. Soc. New York, 1893–94.)

Mammalia.—The three complete skeletons and two skulls of Porpoises collected by Dr. Abbot during his recent cruise among islands north of Madagascar are identified by Mr. F. W. True with *Prodelphinus attenuatus* Gray. Dr. Abbot's notes concerning these specimens include a description of the coloration of each animal when captured so that it is now possible to correlate the external characters with those of the skeleton of this genus. (Proceeds. U. S. Natl. Mus., Vol. xvii, 1894.)

Professor J. T. Wilson regards the dumb-bell-shaped bone in Ornithorhynchus as a true "anterior vomer" formed by the fusion of bilaterally symmetrical halves; and both in its nasal and in its palatine relations it resembles the palatine lobe of the vomer in the alligator *Caiman niger*. (Proceeds Linn. Soc. N. S. W., March, 1894.)

A collection of Mammals from the Island of Trinidad referred to Dr. J. A. Allen and Prof. Chapman for identification adds one species to the list of Bats of that Island, raises the number of known Trinidad Rodents from 7 to 19, and of indigenous Muridae from one to eight, six of which are described as new. (Bull. Am. Mus. Nat. Hist., Vol. V, 1893.)

After a critical survey of the dental and cranial characters of *Ursus cinnamomeus, U. arctos. U. horribilis* and *U. americanus* Mr. A. E. Brown reaches the conclusion expressed some years ago by J. A. Allen,

but subsequently abandoned by him, viz.: that leaving out *maritimus*, none of the North American bears can be accorded a higher rank than that of subspecies of *arctos*. This conclusion was reached after a full study of specimens of skins and skeletons preserved in the museums of America and Europe. (Proceeds. Phila. Acad. 1894.)

Eight new Pocket-Mice, described by Dr. Merriam are commented on as follows by the author.

"*P. baileyi* is a type very different from any heretofore described. It is a large animal with a peculiar skull, which suggests affinities with *P. paradoxus* on one hand, and with *P. formosus* on the other, though much nearer the latter than the former. *P. columbianus* is a peculiar local form of the *olivaceus* group. *P. nevadensis*, *P. panamintinus* and *P. mexicanus* are small forms with much swollen mastoids, belonging to the *flavus-longimembris* group. *P. nelsonii*, *P. stephensii* and *P. canesceus* belong to the *penicillatus* group of the subgenus *Chætodipus*." (Proceeds. Phila. Acad. Nat. Sci., 1894.)

ENTOMOLOGY.[1]

Two New Species of Lecanium from Brazil.—*Lecanium reticulatum*, n. sp., ♀ scale long. 11, lat. 5, alt. 3 mm. Smooth, ridgeless, shiny, dark brown, rather inconspicuously spotted with whitish. These whitish spots are not dermal, but consist of small patches of waxy secretion, which can easily be scraped off. Posterior incision 3 mm. long.

Derm very strongly reticulate, reticulations large, 3, 4, 5 or 6-sided, each with a large oval gland-spot, placed more or less to one side. Walls of reticulations very thick. This reticulation of the derm is easily seen with a lens.

Legs brown, ordinary. Coxa with two hairs at one end, one very long; tibia a little less than one-third shorter than femur; tarsus about one-quarter shorter than tibia.

Tarsal digitules very long, slender, with only moderate knobs, which dilate rather gradually.

Claw short, stout, curved. Digitules of claw small, but extending considerably beyond tip of claw, one larger than the other, stout, with only moderate knobs.

Removed from the bark the insect leaves a patch of white secretion.

A parasitised specimen is only 8 mm. long, and is yellowish-brown, with the reticulation black, very conspicuous with a lens; margin blackish. The parasite must have been a large one, the single hole being over 1 mm. diameter.

Hab., on twigs of an unidentified woody plant, Sao Paulo, Brazil (Dr. H. Von Ihering).

Three were sent, one spoiled by a parasite, the other two in good condition. One of the latter I boiled in caustic alkali, but was not able to obtain all the desirable details from it. The imperfection of the description does not particularly matter, since the species is very easily recognized. It is closely allied to *L. depressum*, Targ., but differs in its very much greater size.

Lecanium baccharidis, n. sp., ♀ scale long. 4½, lat. 2½, alt. 1¼ mm. Dark brown, becoming eventually whitish-brown from a waxy or cottony material scattered over the surface. Where one scale overlapped another, the portion covered is bright orange-yellow with a greenish

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

tinge. Surface wrinkled, but this no doubt largely due to contraction in drying. Dorsum slightly ridged. Posterior cleft fairly short.

Derm with large gland-pits; not at all reticulate. The pits are strikingly large and numerous.

Legs pale brown, ordinary. Trochanter with a long hair; tibia about one-third longer than tarsus. Claw stout, not very long, curved.

Tarsal digitules filiform, not unusually long. Digitules of claw very stout, with large knobs.

Margin with long straight spines.

Rostral loop short, not reaching to insertion of middle legs.

Anal plates broad, when flattened not far from equilateral, but as ordinarily observed in situ with the posterior external side considerably longer than the anterior external side, the two meeting at about a right-angle.

Anal ring with very numerous hairs, which cannot be counted separately.

Antennæ pale brown, 8-jointed, the joints all very distinct. 3 longest. Formula 3 (24) (18) 567. 7 only a little shorter than 6. 4 about $\frac{1}{3}$ shorter than 3. 8 only a little shorter than 4, tapering.

The larger specimens seem quite adult, though they contain neither eggs nor larvæ.

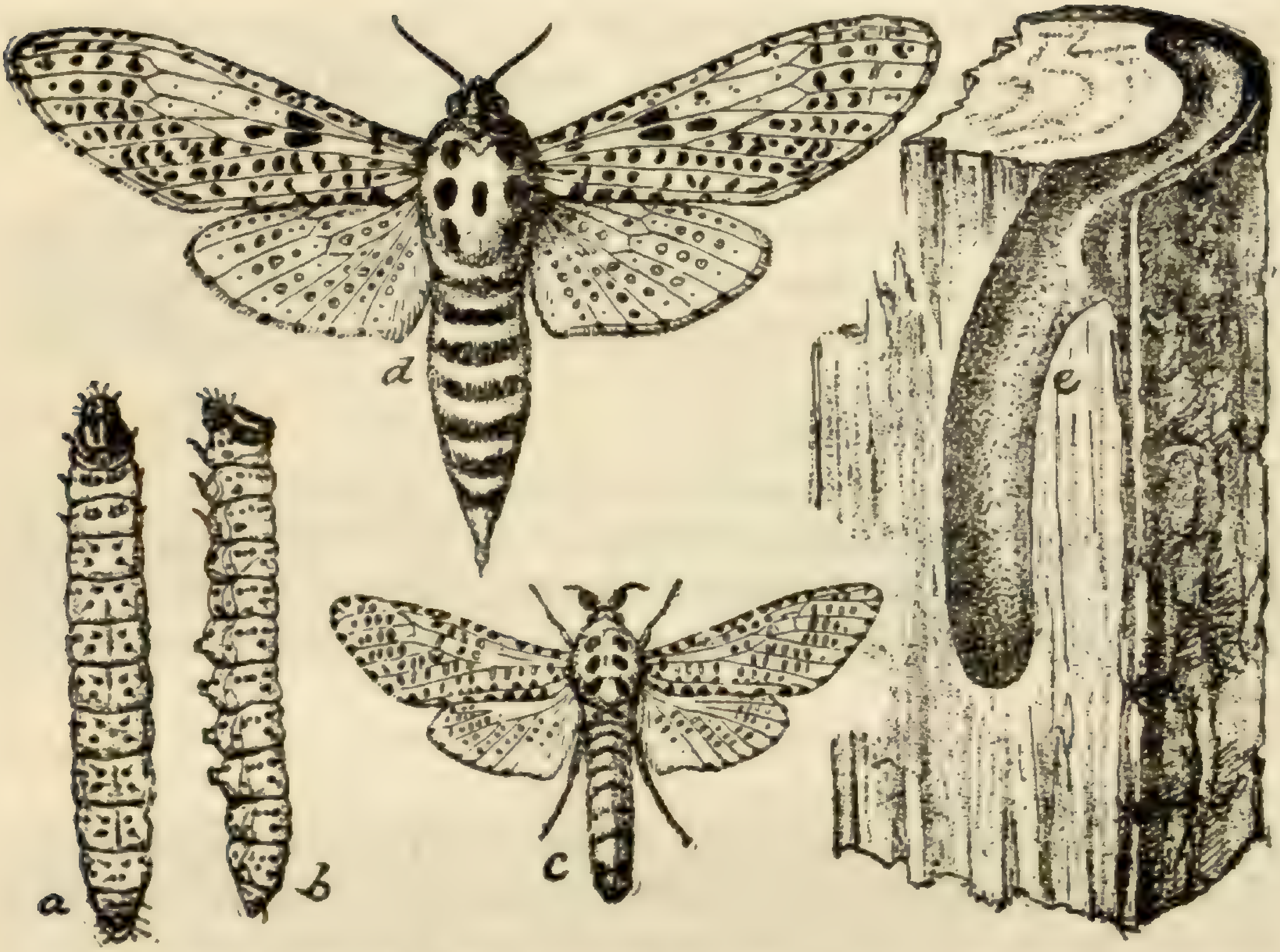
Hab.: Sao Paulo, Brazil, on bark of twigs of *Baccharis* sp., two or more scales sometimes overlapping. (Dr. H. Von Ihering.)

This has the general form and size of *L. hesperidum* (L.), but is a rougher, more opaque form. I do not think it is nearly related to *hesperidum*, such resemblance as exists being merely superficial.

T. D. A. Cockerell, Experiment Station, Las Cruces, N. M.

The Wood Leopard Moth.—There have been frequent reference during the last two years to the ravages of *Zeuzera pyrina* L., a lepidopterous borer of shade-trees, which has been introduced from Europe, and is doing great damage in the parks of New York, Brooklyn and adjacent cities. The various stages of the insect are shown in the accompanying figures from *Insect Life*. Its life-history has recently been summarized by Prof. J. B. Smith, as follows:

"The moths make their appearance in May or June, continuing through July and into August, and are readily attracted to light. It has become the most common species seen around the electric lights in the cities named, and each moth represents a larva that has fed for at least two years in the wood of a neighboring tree, while every female represents the possibility of hundreds of other larvæ to follow the same life history.



The Wood Leopard Moth.—*a*, *b*, larvæ; *c*, male moth; *d*, female moth; *e*, larval burrow. All natural size.

"The eggs are laid by the female moth on the branches, probably placed just into the bark, and the young larvæ bore at once into the wood, usually at the crotch of a small branch, or at a node, and work downward, sometimes just under the bark, sometimes in the solid wood. They grow apace and get into larger branches, still working downward as a whole, but often varying in course; sometimes making it circular, so as to girdle the stick they feed in. For at least two years they feed, rarely emerging from the burrow, though they do occasionally come out for the purpose of changing their quarters and beginning their destructive work elsewhere. Then they change to somewhat slender, brown pupæ, and these wriggle themselves through the bark in due season, and soon after the moths emerge."

The moths, fortunately, are attracted to electric lights, and large numbers of them are thus destroyed. The larvæ may be destroyed by pouring a little bisulphide of carbon in the burrows and then plugging the outer openings of the latter with putty.

Relaxing Insects.—J. P. Mutch writes in *The Entomologists Record* that "rectified wood naphtha, obtainable from any chemist, containing a trace of white shellac, say ten grains to the ounce, applied

to the under side of the extreme base of the wings by means of a very fine sable brush, within a few seconds renders the wings quite pliable; the insect is then placed on the setting-board and set to the required position, braces being used if necessary. In from twelve to twenty-four hours the specimen is ready for the cabinet, showing no trace of the manipulation it has undergone. The shellac is recommended to prevent any possible future springing or drooping, but the pure naphtha produces an equally satisfactory effect so far as relaxing goes. The old, tedious process of damping may thus be obviated, and the most delicate colors left uninjured."

Eyes of Phalangiidæ.[2]—Herr F. Purcell finds two types differing in the structure of the rhabdome—the Liobunum type and the Acantholophus type, and describes these in detail. We can only cite a few outstanding results.

One of the most important characteristics of the retina is the constant arrangement of its elements in groups (retinulæ), each of four cells, and the union of the optic rods of these four cells into a rhabdome, which, though single, is composed of four rhabdomeres. There are no pigment or other cells between the retinulæ.

In all the species examined the rhabdome consists of two chemically different parts. The one part includes the whole central rhabdomere, and in the Acantholophus group the distal portion of the peripheral rhabdomeres. The other part includes in the Liobunum group the whole of the peripheral rhabdomeres; in the Acantholophus group only the proximal part of the same.

The eyes of the Phalangiidæ are three-layered inverse eyes of ectodermic origin. The anterior median eyes of spiders, the eyes of Phalangiidæ, the median eyes of scorpions, and at any rate the median eyes of the king-crab, form a series of homologous structures, characterized by an inverted retina with retinulæ or at least rhabdomeres. As a chief result of his investigation the author claims to have definitely proved that a retina composed of retinulæ, or of a modification of these, occurs in the higher Arachnid orders—Phalangiidæ and spiders. (Journal Royal Microscopical Society.)

Spread of Otiorhynchus ovatus.—Mr. H. F. Wickham publishes in *Societas Entomologica* (Dec., 1894) a short paper on the distribution of *O. ovatus* of such interest that we reprint it entire:

"This Euro-Asiatic species has been for some time known as an inhabitant of the United States, but has hitherto been supposed to be

[2] Zeitschr. f. Wiss. Zool., LVIII., pp. 1–53.

restricted to that portion east of the Mississippi River and north of the thirty-ninth or fortieth parallel. I have lately become possessed of additional data regarding its range, which I herewith record, adding also a number of already published but scattered notes—the whole giving a tolerably complete idea of the American distribution of the insect.

"When known, the year of first capture is also given, though often we can only tell from the date of a given reference that the species was known in that locality *previous* to that time; hence no exact generalizations as to the path or rate of westward progression can be based thereon. A considerable portion of the matter, however, has been gathered directly by correspondence with entomologists in various parts of the country, who have kindly responded to my requests for information, and whose names will be found appended thereto.

"In a recent number of *Insect Life* it is stated by Messrs. Riley and Howard that it was first recorded from the United States in 1873. Not being able to find the reference, I wrote to Mr. Samuel Henshaw, asking help of his unsurpassed knowledge of the bibliography of American beetles. He kindly replied as follows:

"'The Leconte collection contains a specimen of *ovatus*, No. 1952 of his manuscript catalogue. Against this number Dr. Leconte wrote "pear tree, Harris, Mass." As Harris collected all his beetles between 1820 and 1852, *ovatus* must have been here (Massachusetts) as early as 1852. The late Mr. J. P. Atkinson collected the species at Cambridge Sept. 2d, 1865, and there is a specimen in the Leconte collection taken by Mr. Schwarz in Cambridge, March 20th, 1874. My earliest specimen is labeled Wyoming, Mass., May 30th, 1874.'

"It was thus evidently established in Massachusetts by this time; a year later it was at Allegheny, in Pennsylvania, as Dr. Hamilton writes me from that place. 'I took this beetle in a cemetery here in 1875, and it was then apparently abundant. A couple of years afterward it was excessively so, in the same cemetery, but is now (1894) much less common than formerly.' By 1878 it had reached Detroit, Michigan, when it is recorded in the Hubbard and Schwarz List. Mr. Henshaw had it from Hanover, New Hampshire, as early as 1880. In 1884 it came under Dr. Lintner's notice in New York, but Mr. Reinecke found it at Buffalo at least two years earlier. About 1882 or 1883 it figured as a strawberry pest in Southern Michigan, and the year 1884 brings a record from Ottawa, Canada, by Mr. Harrington. Not later than 1886 I took it at Iowa City, the record standing for years as the most westerly range known for the species.

In the East, however, it was still being taken at new points, as the following notes show, the dates being those of publication: Nova Scotia, 1889; Chicago, Illinois, 1889; Wayne County, Ohio, 1892; Quebec, 1892; Indiana, 1892; New Jersey. The western range has been greatly extended by the capture of this insect at Laramie, Wyoming, in 1893, by Mr. Niswander, and at Santa Fé, New Mexico, by Mr. Cockerell, in July, 1894. the specimens in both cases being sent me for identification.

"It will thus be seen that the recorded distribution is very much extended of late, and the species by no means restricted in range. Though the dates are insufficient for the tracing of the exact path of the insect, it at least appears to have slowly spread westward and southwestward from the New England States, where it may have been introduced from Europe. From the scattered records and the absence of *O. ovatus* from many points within its range, worked by diligent collectors, I judge that it is not very aggressive in invading new territory, but doubtless tolerably easily introduced in shrubbery or other nursery stock.

"A word as to food-habits here, and I am done: Dr. Hamilton takes it on various bushes. It has been recorded from muskmelon (Webster), strawberry (Weed), borage (Cook), currant (Mrs. Wickham). Mr. Webster also found it breeding in roots of blue-grass. At Iowa City it has been found under boards, and often in bunches of pine shingles. The habit of thus creeping into crannies would greatly aid in extending the distribution by artificial means and explain its appearance in new localities where it could not have been introduced with plants."

EMBRYOLOGY.[1]

Development of an Isopod—The first paper of M. Louis Roule on the development of the Crustacea has just appeared.[2] He has studied, as a representative of the Edriopthalmia, the Isopod, *Porcellio scaber*, Leach, with especial attention to the first stages of development. The origin of the blastoderm, of the germ layers, and of the rudiments of the organs, are considered in great detail, and there is, besides, much general discussion on the significance of these processes among Arthropods. This first paper will be followed by three others; one on the Decapods, one on the Copepods and Branchiopods, and a third on general questions.

Though Bobretzky, in 1874, established the chief features of the development of Isopods from a study of *Oniscus murarius*, a detailed examination of the development of the group was much needed; and M. Roule has also wished to throw more light on the question of relationship between Annelids and Arthropods. He has been led to believe that the early stages of the Crustacea do aid us materially in testing such an affinity.

The eggs of *Porcellio scaber* develop in the brood chamber of the mother, the early stages (including segmentation, the formation of the blastoderm, and establishment of the germ layers) requiring a proportionately long time, about two weeks, while the rest of embryonic development takes but three weeks.

The unsegmented ovum is mainly a mass of nutritive yolk, with the greater part of the formative material on the surface in the form of "*islands*" of protoplasm. The food yolk consists of a great number of large vitelline granules in a protoplasmic groundwork. Toward the periphery the granules are smaller, and the islands of formative yolk, though finely granular, are mostly formed of the protoplasmic groundwork. In a surface view one of the islands of protoplasm is found constantly at the anterior pole, and is seen to be larger than the others. This is the germinal disc, and it contains the only nucleus in the ovum. The other islands have no constant position or size; they are continuous with the central deutoplasm (as is also the germinal disc),

[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts, reviews and preliminary notes may be sent.

[2] Annales des Sciences Naturelles, Vol. xviii, Nos. 1, 2, 3 (sér. 7), with 10 plates.

and separated from one another on the surface by deutoplasm. The nucleus in the germinal disc divides, and its descendants scattering in the protoplasm form a syncitium adherent to the surface of the food yolk. As the disc spreads, the central protoplasm divides up into cells around its nuclei, while the periphery remains a syncitium. This syncitium is soon broken up into cells, and as the blastoderm thus formed extends, it annexes more formative material as it reaches the islands of protoplasm. The periphery of the blastoderm is thus continually added to, and the protoplasm forming the growing edge is constantly supplied with nuclei from the centre of the disc, around which in their turn new cells are formed. Besides the protoplasm added from the islands, formative material is also supplied from the centre of the ovum among the deutoplasm. In this way the blastoderm gradually extends over the egg from the anterior pole ventrally and laterally, until it finally closes in at the posterior pole near the dorsal surface. (This type of segmentation seems to fall between Korschelt and Heider's III b. and IV.) Soon after the first cells of the blastoderm have become well defined at the anterior pole, they begin to split off an under layer, the mesentoderm (Roule's protendoderm). This layer is steadily added to as the blastoderm spreads, by a repetition of this process of splitting tangentially, by incorporating new cells thus formed at the anterior edge of the blastoderm, and by a division of its own cells. The anterior pole of the egg is the growing point of the mesentoderm. The cells lie for the most part along either side of the ventral mid-line, in two ridges projecting into the yolk, in the anterior region of the embryo. The cells being amoeboid, however, wander dorsally and posteriorly, where they lie as elsewhere in the outer portions of the deutoplasm. By this time the cells of the ectoderm have flattened, except in two regions, into a single layer. At one place where the brain is to appear, a rapid division of nuclei and fusion of cells takes place, until a syncitium is formed projecting into the yolk. A similar syncitial mass is formed on the ventral mid-line, to be the ventral cord. These two areas are connected by ectoderm, which will later be the œsophageal ring. Nineteen pairs of appendages gradually appear from before backward. At first they are formed of an ectodermic sheath with a core of nutritive yolk and scattered mesentoderm cells; but soon the nutritive yolk is absorbed, leaving merely the mesoderm cells within. While the nervous system is becoming more distinct, and the appendages are growing and increasing in numbers, a proctodeal invagination, which appeared at the point where the blastodermic disc closed in, and a stomodeal invagination, which appeared at the

anterior pole, both grow into the yolk mass towards the centre of the egg. The proctodeum is a narrow, straight tube, which finally reaches the anterior portion of the body and comes into contact with the stomodeum. The latter begins in a short, straight œsophageal portion at the base of the mandibles, which is distended at its central end into a vesicle resting against the blind end of the proctodeum.

The most striking changes during this period are, however, found in the mesentoderm. It becomes differentiated into two layers, mesoderm and endoderm. The mesentoderm (or protendoderm) has, as has been seen, collected especially in the anterior end of the body, on either side of the median line. In the rest of the body it formed a layer of scattered cells in the surface of the yolk under the ectoderm. The lateral anterior masses become slowly marked off into a dorsal and a ventral portion. The dorsal portion forms a plate of cells on either side of the median plane in the anterior region of the body. The ventral part forms two ridges of cells (one on either side of the ventral mid-line), which are numerous, closely packed, and run down into the appendages. At the base of each pair of appendages there is a collection of these cells, to become muscles of the limbs. This gives the mesodermic ridges a metameric appearance. The two lateral dorsal plates become more and more clearly defined and enlarged. They are concave toward the yolk mass enclosed between them, and as they grow and meet on the mid-line, they unite. In this way a mass of yolk in the centre of the embryo is gradually included in a layer of cells, endoderm, originating from the mesentoderm. Since, however, the union of the endodermic plates is gradual, and since they meet first anteriorly and ventrally, the enteric vesicle formed by them is open behind and above for some time. The endoderm is now distinctly marked off from the rest of the mesentoderm, and has arisen from anterior lateral collections of this layer and from its dorsal portion. The rest of the mesentoderm becomes mesenchymatous mesoderm. It is found everywhere beneath the ectoderm, especially ventrally. One other thing is more and more evident in this region, where the mesoderm is collected most: the yolk has been absorbed gradually, and the mesenchymatous elements are here bathed in plasma. This absorption of yolk will continue rapidly from now on, proceeding from the ventral toward the dorsal surface of the embryo.

During the last period of development profound changes take place, ending in the fully-formed young crustacean ready to leave the egg-membrane. The ectoderm soon secretes a cuticle, while the appendages elongate and become segmented. Those belonging to the head draw

together around the mouth, and those in the abdominal region flatten and become pleopods; while the thoracic limbs become the longest appendages of the body, with the exception of the second antennæ. At first there is no external segmentation of the body, but gradually a head region is marked off from the thorax by a groove. Posteriorly, the thorax and abdomen are also pretty clearly marked, the latter being of smaller segments. The grooves between the segments appear first ventrally and grow up towards the dorsal surface. Later dorsal grooves appear and grow down to meet the ventral ones. Finally the abdominal, and the two or three most anterior thoracic segments, are completely marked off by circular grooves. The thorax is the last region to become segmented. Its mid-dorsal portion is raised into a peculiar hump, which is very prominent for a time, but gradually disappears as the development proceeds to a finish.

The proctodeum and stomodeum have gradually approached and met in the thoracic region as described, and finally the point of union breaks through, and the digestive tract is continuous in its whole length. In the first period the enteric vesicle had become almost entirely closed in around a mass of yolk in the centre of the embryo; now it is entirely closed and becomes greatly changed. A deep groove pushes in along its ventral surface from in front backward. It deepens towards the dorsal surface, and finally meets a groove from above. They split the enteric vesicle into two halves which are however united anteriorly by an unsplit portion. This anterior stem, bearing the two enteric lobes behind, (later on the two primary enteric lobes split into two secondary each) lies just at the point where the proctodeum and stomodeum meet, and where their cavities become continuous it opens into the alimentary canal thus formed. As M. Roule says: "Such a disposition is found among all crustacea, with the constant relation of the enteric vesicle with its lobes attached to the digestive canal in the zone of union of the anterior and posterior intestines." "Considering the entire digestive tract then, the whole system, canal and annexes, originates from three rudiments which are at first independent of each other and later joined into a single system. Two of these, the stomodeum and proctodeum, arise from the ectoderm, while the third comes from the entodeum. A like structure and like triple origin is to be found in the other Arthropods, but with an important difference: the proctodeum does not extend so far into the body as that of the Crustacea; its anterior end remains some distance behind the enteric vesicle; it unites with the enteric vesicle at its posterior end,

while the stomodeum joins the vesicle at its opposite end. The enteron is thus interposed between the anterior and posterior intestines, becomes a part of the digestive canal and forms the mid-gut, which Crustacea almost completely lack." The endoderm, hence, arises internally from the protendoderm, and not by invagination. There is no gastrula among Arthropods, the apparent gastrula invaginations being really stomodeal invaginations. The alimentary tract arises from three rudiments in an entirely different way from the process followed in animals with true gastrulation. Every little depression on the Arthropod blastoderm, M. Roule says, has been thought to be a gastrula when once the necessity for finding one was thought established by the early workers on the germ layers. However, gastrulation is not so important as the results of it, and M. Roule suggests that a very important difference between Arthropods and other Cœlomates is the fact that their digestive tract is not formed from any of the so-called gastrulas.

(It will be noted that Heymons, in a recent paper, has also given up the idea of endoderm formed from a gastrula invagination, deriving the whole digestive tract in insects from the stomodeum and proctodeum. Korotoneff, too, has adopted Heymons' view to a great extent.)

As development proceeds, the yolk enclosed by the enteric vesicle is gradually absorbed, the brain and ventral cord become differentiated, and the yolk mass in the body cavity is rapidly reduced. This reduction is effected by phagocytes floating in the plasma, which washes the edges of the yolk. They eat it away until it is confined to the dorsal portion of the thorax, where it forms the hump mentioned above. Besides these wandering cells, other cells of the mesoderm elongate become grouped together and form muscle bands criscrossing through the body cavity. By the end of this period all trace of metamerism has vanished from the mesoderm. The appearance of metamerism, noticed at an early stage, was due to collections of mesoderm cells at the bases of the successive pairs of appendages, before they had pushed out sufficiently to accommodate those cells destined to shove in and form the inner structures of the limbs. The disappearance of this apparent metamerism in later stages is due to the segmental collections of cells having moved into the limbs to their definitive position. "This fact shows undoubtedly how the metameric disposition of the ventral mesoderm is bound up in the distribution of the appendages in regular pairs as cause to effect. The first is the result of the second, and has no other value whatsoever."

In speaking of the external segmentation of the body, M. Roule says:

"The annelidan structure of the organism manifests itself at a later date than the production of the appendages. The folds between the rings pass rigorously between the pairs of appendages. The relation of cause and effect is apparently evident. This structure is, as the temporary metameric disposition of a part of the mesoderm, a result of the presence of limbs on the body and of their distribution in pairs placed regularly one behind the other at equal or almost equal distance apart. The object is to facilitate movements of the body especially flexion, and is of no other importance. The morphological value of this segmentation of the body into a metameric series is hence most plain; it is secondary, and not primitive, in spite of its analogy to annelids and vertebrates, and it is to be associated with the existence and arrangement of the paired appendages."

In another place the difference between the metamarism in the two groups is put as follows: "In the annelids the metameric division of the mesoderm is due to a regular increase of cavities in this layer from one end to the other. The appearance of such spaces is not at all dependent on the presence of appendages, for it precedes their origin and takes place even when they are lacking. Finally these cavities enlarge equally and surround the intestine."

As to the Arthropods: "Only a part of their mesoderm assumes a metameric appearance, the rest remaining mesenchymatous. This segmental arrangement is not at all a result of multiplication of cavities, but the result of a compact grouping of cells due to an inequality in multiplication. The spaces which appear finally in the mesoderm are irregular, numerous, and in no way related to the segmental arrangement. This is dependent on the presence of appendages, since it is established after these are produced and so that a metamere lies above each appendage. The relation is so intimate as to compel the inference of cause and effect. Finally, in no case do the mesodermic cavities enlarge in a regular way to surround the intestine."

Before the embryo is set free, the hump on the back, due to the yet unabsorbed food yolk in the dorsal part of the body cavity, disappears on the complete absorption of this yolk. This hump has been described as a "dorsal organ," but it is easily seen to be no organ at all, merely the last of the food yolk.

M. Roule devotes considerable space to the establishment of his view as to the formation of the germ layers in Arthropods and their homologies with those of other cœlomates. He regards the whole process of the spreading of the disc-shaped blastoderm as a process of planulation. No epibolic gastrula is formed, he claims. The planulation

consists in splitting a central layer of cells belonging to the food yolk from a superficial ectoderm. The protentoderm does not arise, according to this, from the ectoderm, but both layers are the result of a division of the blastoderm. Just as in any planula of this sort (lecithal), there is an external epithelial layer of cells, while the internal ones are connected with the yolk.

Other Crustacea show a simpler and more typical planula. Here, after a total segmentation resulting in a collection of pyramidal cells, the central ends containing the yolk divide off, forming an inner layer of cells (protendoderm), while the peripheral remains as the ectoderm. In the Isopods the mesentoderm separates from the yolk mass as amœboid cells. In insects the condition is more complicated, but essentially the same. The cells produced from the formative yolk travel to the periphery and become the blastoderm, which divides as in the Crustacea into the mesentoderm and ectoderm. The cells from the centre, which do not reach the blastoderm before its splitting into two, are really blastoderm cells retarded from becoming ectoderm. They become mesentoderm cells. M. Roule distinguishes them by the term "inner blastoderm."

"By whatever method formed, the resulting planula is composed of a peripheral blastoderm and a central deutoplasm. It is centrolecithal. This planula is peculiar to Arthropods and some Hirudinea."

"The lecithal planula of other animals belong to Cephalopods, some Tunicates, and many vertebrates (Teleosts, Selachians, Sauropsida). Here, too, the central yolk mass is enclosed by a disc gradually spreading over the surface; but in these cases the blastoderm divides into two parts, one thick, situated at the place where the disc started to spread, and alone destined to give rise to the embryo, while the rest is reduced to a thin membrane, limiting the yolk and absorbing it, but not forming any part of the adult. These two portions of the blastoderm are the embryonic zone and the vitelline zone. They are contiguous, and the nutritive mass is not placed in the interior of the young individual. In Arthropods the condition is quite different. The blastoderm is entirely embryonic, and encloses all the deutoplasm which forms an *internal* vitelline vesicle, and not a contiguous one. The centrolecithal condition of the planula and the genetic unity of the blastoderm so constant among Arthropods, lends to these creatures an autonomy separating them from other cœlomates."

The germ layers of Arthropods are not, according to M. Roule, homologous with those of other cœlomates. The ectoderm, however, he believes to be homologous in origin and history in all cases. Homology

means to him identity of origin in time and space, and he believes that two systems with like fates, but dissimilar origins, are not homologues.

The protendoderm of Arthropods is a mesenchymatous tissue arising by migration, as in a planula of the hydrozoa. That of other cœlomates is epithelial from the start, and arises by gastrulation. Hence, in origin and character the two are essentially different.

"The investigations of many observers on the development of sponges and hydroids have shown that in the cœlenterates the germ layers may be formed by other processes than gastrulation. To-day it seems to M. Roule impossible to consider the germ layers of the metazoa as homologous. They differ from one another in origin. The protendoderm (mesentoderm) of Arthropods does not correspond to that of other Cœlomates; but among Arthropods it is homologous, and among other cœlomates it is homologous. The difference between the lecithal planula of Arthropods and similar ones of other cœlomates lies in the origin of the endoderm in the latter by a true gastrulation.

H. Mc. E. Knower.

ARCHEOLOGY AND ETHNOLOGY.[1]

Discovery of Shell Mounds in Chira Valley, Peru.—It was my good fortune, during the last four years, to discover in the Chira Valley in the northern Part of Peru, a vast field of antique remains hitherto unknown to the scientific world. The Chira River which is the most northernly of the important coast streams running from the Andes to the Pacific, is situated about one hundred and fifty miles from the frontier of Ecuador, and nearly six hundred miles to the north of the great Ancon necropolis, recently so exhaustively studied by Reiss and Stübel. Between the Chira and Ancon are two fields already well known—one the great Chimer and Trujillo and the other near Chimbote in the Santa Valley—Trujillo lies some 225 miles to the south of the Chira.

Fifty or sixty miles north of the Chira is a smaller valley called the Pariñas. Between the two is a desert region extending inland to the La Brea Mountains, a distance of thirty miles. These two valleys and the intervening territory, an area of 1800 square miles, comprised my field of work. The exact locality may readily be determined upon any map of South America as it embraces Point Pariñas which is the most westerly Cape of the Southern Continent.

It was among the ruins and graves of the Chira Valley that I gathered the Collection of Antiquities now deposited in the Museum of the University of Pennsylvania. These ruins and graves occupy as a rule all the untillable land on the northern side of the valley from the town of Sullana to the mouth of the River, a distance of forty or fifty miles. The ruins are unique among those I saw in Peru. They lie in groups four or five miles apart and consist of terraced temple platforms of three stories, built of clay reinforced with conical shaped adobes. The whole edifice is about three hundred feet in length and breadth at the base and seventy-five feet in heighth. Adjoining these pyramidal structures are always found extensive traces of adobe walls, doubtless the remains of the foundations of priestly dwellings, for it is fair to suppose that these monuments had a sacred character. At the foot of the ruins are arranged numerous hillocks thickly covered with small white bivalve shells. Under the shells the soil is full of fine ashes and sherds of pottery. The surrounding plain is always crowded with graves, often three or four tiers deep to a depth of twenty-five feet. A

[1] This department is edited by H. C. Mercer, University of Pennsylvania.

feature of these graves seems to prove one of the statements made by Cieza de Leon in his account of the Civil Wars in Peru. According to him the natives of this northern region were in the habit of sacrificing at their burials and of throwing the remains of the sacrifice into the grave. In excavating I found the soil above the graves thickly mingled with charcoal, burnt bones, ashes and other refuse. In addition to this refuse I also encountered numerous white shells, both bivalve and spiral, in the sand, and the entire surface of the necropolis is lightly covered with similar shells which have probably been washed out by the rains. As it is to the constant occurrence of the small white shell in the graves and other remains of this region that I wish to draw attention, I shall omit here any description of the graves themselves.

In the Pariñas Valley the ruins are less elaborate in character. At the mouth of this river, close by the sea, is a large artificial mound about an acre in extent and thirty-five feet high, filled with bones and fragments of coarse pottery. Occasionally it is possible to find a rough pot or olla of burnt clay. Close to this mound are several smaller ones of similar character. All of these, including the great mound, are covered on the surface with the white shells. Throughout the valley, wherever natural elevations have been used as burial places, these shells again occur and the pottery of the graves is of the same low order. Ruins of adobe walls, sometimes buried several feet below the present level of the valley, are also to be found at several places along the Pariñas River.

There are in the desert itself three or four wells in the neighborhood of which are buried ancient walls. Associated with these walls we invariably find some natural elevation, containing bones and pieces of pottery, covered with the shells as in the Pariñas Valley. Everything seems to indicate that these ruins at the wells and along the Pariñas belong to much earlier epoch than those which exist in the valley of the Chira.

In the very heart of the desert, however, I found remains of an entirely different order. These are situated about twenty-five miles south-west of Point Pariñas four miles from the sea shore. At this point for several square miles the plain is crowded with irregular mounds, some forty or fifty feet in height, composed entirely of white bivalve shells slightly mixed with sand. These might be taken for natural formations were in not that each contains a central core which is filled with charcoal, burnt shells and other signs of fire. Owing to my work in other directions I was not able to devote much time to these mounds. Although repeated digging revealed neither bones nor

pottery, I am convinced from the charcoal and other indications that these remains are of human origin and I am thus able to make known for the first time the existence of the true shell mound in Peru. That these mounds are mere heaps of loose shells rather than compact masses, as in Florida, and other places is no argument against their great antiquity, for in the practically rainless desert region in which they are found they might easily have remained unchanged for many ages.

Before attempting to draw any conclusions from the data afforded us by the different classes of remains which exist in this locality about the Chira Valley, it will be necessary ta take a brief survey of what is known of its history. We have but one authority on this subject, Garcilasso de la Vega, and although his account is far from being a model of either history or chronology, it is certainly based upon tradition and is therefore full of suggestion. When the Incas set out to conquer the coast valleys they found them occupied by a warlike and well advanced race called the Yuncas, whose chief centre of power extended from the Chincha Valley near the modern Pisco, to the great Chimu at Trujillo while their dominion reached over all the surrounding tribes. According to their own legends these Yuncas were of foreign origin, and their ancestors, after affecting a landing in Peru, had through sheer innate superiority conquered their barbaric neighbors, and laid the foundations of the great nation which in time grew to the proportions in which the Incas found it. After subduing the Yuncas, the Incas proceeded northward and in the remote valleys of that region encountered a people of so low a condition, so poor and bestial that it was necessary to compel them to pay tribute in lice in the hope of teaching them the rudimentary principles of cleanliness. The Chira was one of these outlying valleys, but the millions of graves which it contains and the high civilization which they reveal, prove at once the chronological inaccuracy at least of de la Vega's story. It is probable that his errors arose from confusing Incan and Yuncan traditions, and that it was the Yuncas and not the Incas who came in contact with the barbarians.

It is hardly possible to suppose that the people of the shell mounds could ever have risen through their own efforts to so high a level as was obtained by the inhabitants of the Chira; it is even improbable that they could have done so with the aid of extraneous influence. A more likely theory is available. Before the coming of the Yuncas, a shell mound tribe occupied the desert adjacent to the mouth of the Chira and were either exterminated by invaders or had ceased to exist before their arrival. After the manner of all semi-civilized or semi-

barbaric peoples the new comers regarded the gleaming white shell mounds of their predecessors with superstition, attached to them a sacred significance and were not long in incorporating the shell into their own ritual. This we see in the shell *covered* mounds and burial hills of the Pariñas Valley. In the Chira Valley we find that an advance has been made, the burial mound of the Pariñas here becomes the temple platform and the shells appear on the hillocks surrounding it and in the grave fillings. It is true that these hillocks seem to have been ovens in which pottery was baked, but this in no way alters the significance of the shells which cover them. The pottery, especially the fantistic and carefully finished pieces found in the graves, must have had a ritualistic meaning and the ovens in which it was baked must also have been regarded as sacred, and when no longer used were consecrated with a covering of the revered shells.

A more difficult problem seems to present itself in the difference which exists between the remains of the Pariñas and those of the Chira. Tradition again aids us in overcoming it. There is a story that the Pariñas Valley was once thickly populated (it is now practically uninhabited), and that for some reason, probably drought or plague, the people were compelled to abandon it and seek homes in the valleys to the south. This migration probably took place prior to the epoch in which the custom arose of symbolizing the mound in the temple, and before the pottery art was so highly developed as it latterly became. This desertion of the Chira Valley at so early a period has therefore preserved for us an important link in the chain of the nation's progress.

This view of the adoption of the shell of the old kitchen mounds as a sacred token by the conquerers or successors of the primitive race, serves also to explain the comparatively limited extent of such mounds, for undoubtedly the shells of the graves and ruins were obtained from these deposits and in this way many of the old mounds were destroyed. This theory also accounts for the absence of shells in the other grave fields of the coast.

As I said before this necropolis of the Chira is new to science and is deserving of attention and exploration. It presents many unique features in Peruvian Archeology. The bodies are buried horizontally at full length, with the head resting on the left shoulder and the face turned in the same direction, whereas in other regions the body is invariably trussed up in sitting posture with the knees drawn under the chin. I also found that the use of the labret was common among the females, a custom hitherto unknown among the tribes of the coast regions of Ancient Peru.

From the tools and other implements which I brought back, Mr. Frank Hamilton Cushing of Washington has been able to prove that the lacquer art was known to those people; that the goldsmiths art, of which it is possible to show all the processes, was very cleverly practiced, and lastly he has been able reconstruct for the first time the ancient Peruvian loom and to demonstrate the methods by which all the intricate fabrics of that time were woven. It is sincerely to be hoped that before long he will be able to present these wonderful and most valuable discoveries to the world.

—SAMUEL MATHEWSON SCOTT.

Mr. H. A. Pilsbry, of the Academy of Natural Sciences of Philadelphia, has kindly identified the shell specimens collected by Mr Scott at these shell heaps, as *Spondylus princeps* (Brod.), Gulf of California, etc.; *Natica panamensis* (Recluz.); *Trivia radians* (Lam.), St. Elena, west coast of Columbia, *Donax radiatus* (Valenc.), Mazatlan to Valparaiso; *Terebra fulgurata* (Philippi), Mazatlan. The large thorny Spondylus would, he says, roast well. The delicate little Donax would make excellent soup, and the Natica would be found as edible by the Peruvian Indian as its Periwinkle brother has been by the North American Red Man, whose shell heaps and village sites are thickly strewn with it. The modern Londoner, as Mr. Pilsbry informs me, eats tons of the same snail yearly. Minute Terebræ and Olivæ, if not boiled for soup, might have done for trinkets.

H. C. MERCER.

The Neanderthal Man in Java.—Dr. Eugene DuBois of the Army of the Netherlands has recently published in Batavia, Java, in a brochure in quarto, an account of some bones of an interesting quadrumanous mammal allied to man, which were found in a sedimentary bed of material of volcanic origin, of probably Plistocene age. The remains consist of a calvarium which includes the supraorbital ridges and a part of the occiput; a last superior upper molar; and a femur. The tooth was found close to the skull and probably belongs to the same individual as the latter, while the reference of the femur is more uncertain, as it was found some fifty feet distant.

The characters of the skull are closely similar to those of the men of Neanderthal and of Spy, but the walls are not so thick as those of the former, and more nearly resemble those of the latter. The frontal region is, therefore, much depressed, and it is also much constricted posterior to the postorbital borders. The sutures are obliterated. Much interest attaches to the cranial capacity, which Dr. DuBois

states to be just double that of the gorilla, and two-thirds that of the lowest normal of man, bridging the gap which has long separated the latter from the apes. Thus the capacity of the former is 500 cubic c. m.; and the latter is 1500 c. c. m. In the Java man the capacity is 1000 c. c. m. The last upper molar has widely divergent roots as in apes and inferior races of man, and the crown is large, with the cusps not clearly differentiated, showing a character commonly observed in the lower molars of the gorilla. The femur is long, straight, and entirely human.

This important discovery of Dr. DuBois adds materially to our knowledge of the physical characters of the paleolithic man, and especially to his geographical range. As is well known, his remains have been found hitherto in Europe only, (Neanderthal, Spy, Naulette, Shipka, etc.), but now it is evident that he ranged over almost the entire width of the Old Continent. This discovery confirms the anticipation expressed by evolutionists, including those published in the NATURALIST for April, 1893, (The Genealogy of Man), and October, 1894.

As regards the proper apellation of this being, Dr. DuBois is not entirely happy. He proposes for him a new genus, Pithecanthropus, (after Haeckel), and even a new family, Pithecanthropidæ, without having shown that he is not a member of the genus Homo. It is not certain that he is not an individual of the species *Homo neanderthalensis.* His cranial capacity is less, it is true, than that of the man of Spy, and it is possible that this really constitutes a character of specific value. Disusing then, Dr. DuBois' name Pithecanthropus, we have left as the appellation, *Homo erectus* DuBois. This name is distinctly absurd, as it is applicable to all members of the genus Homo. The law of priority, however, requires that we use it in case the species is new.

It is interesting to observe the differences of opinion expressed by paleontologists as to this discovery. Prof. Marsh, in a late number of the Amer. Journ. of Sci. and Arts, adopts Pithecanthropus and Pithecanthropidæ; while Dr. Lydekker, in Nature, expresses the opinion that the remains belong to a microcephalic idiot.—E. D. COPE.

MICROSCOPY.[1]

On a New Method of Entrapping, Killing, Embedding and Orienting Infusoria and other very small Objects for the Microtome.—A reliable method for capturing, killing, staining and dehydrating minute organisms has long been a desideratum with biologists, especially when such objects fall far below 1–100th of an inch or 1–40th mm. in diameter. After trying a number of devices, all of which failed, I fortunately hit upon a plan that is not only very simple, but also capable of wide application, since I find that by its means organisms as small as 1–2000th inch or 12.5μ in diameter may be caught and held.

With the ordinary methods of filtration through the filter paper it is not possible to afterwards separate minute organisms thus captured from the surface of the substratum of paper. This difficulty has been overcome in my new method by means of a filter that *can* be easily cut in the block along with the objects adherent to its surface and within its meshes, a procedure quite impossible with filter paper. While filtration is the basis of this new method, and the use of ordinary filter paper is an essentially important part of it, it has been found necessary to find a substance that would serve as a filtering membrane that was porous, but not fibrous, because the presence of fibres is fatal to any attempt at cutting good sections in paraffine. On such a filtering membrane the organisms are caught and held where they are killed or fixed with any reagent, stained, dehydrated, and embedded, filter and all, in paraffine by means of the watch-glass method.

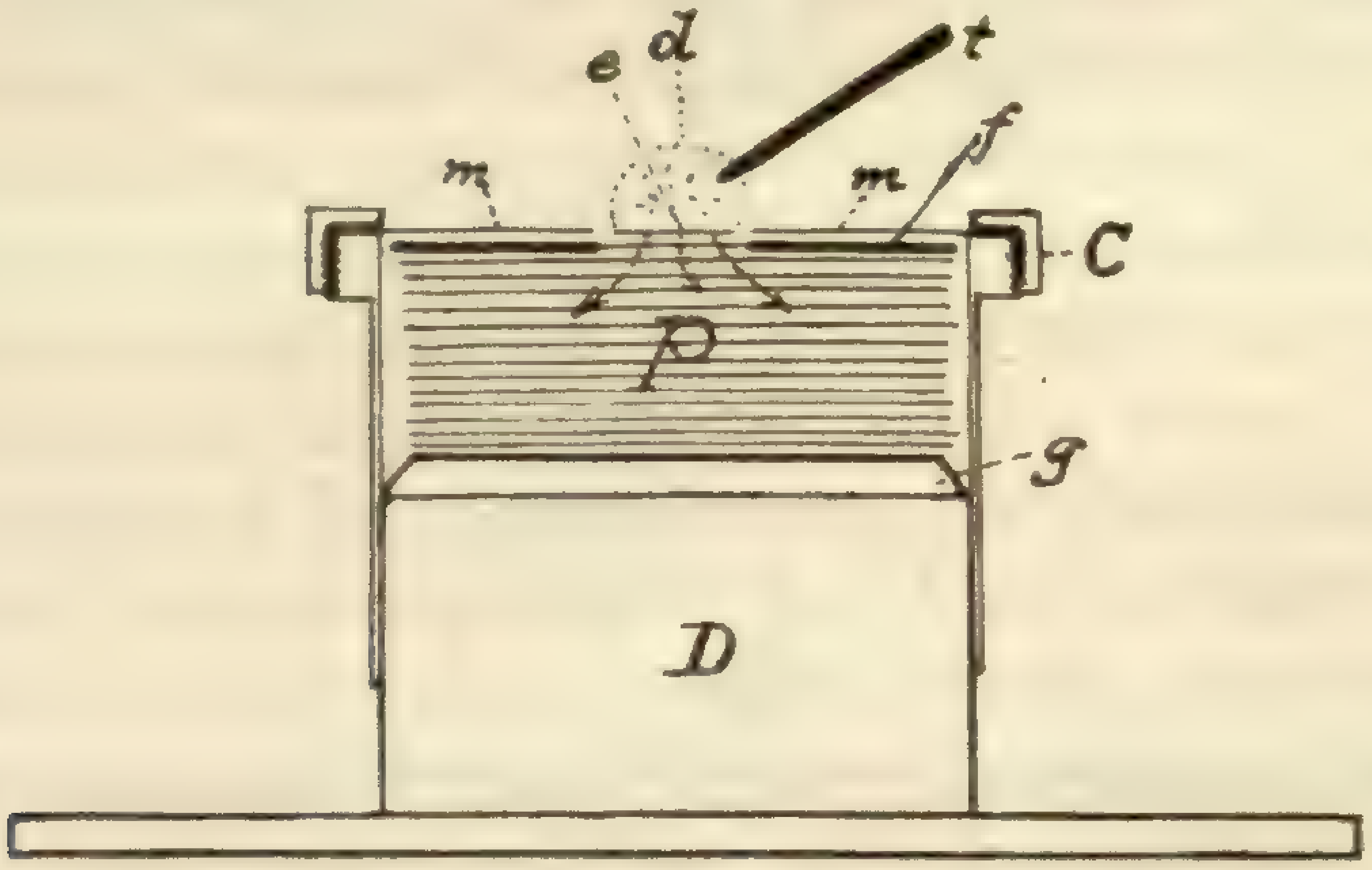
The filter upon which the objects are caught and killed consists of thin slices of elder pith. Get good, clean, whole pieces of elder pith, and clamp a piece of it into the holder of a Schanze or other sledge microtome, so as to make transverse sections of it, taking about four to six divisions of the micrometer wheel to each section. The microtome knife should be set at an acute angle with the line of movement of the knife carriage, as in cutting celloidin. With fresh pith, somewhat thinner sections may be cut. Upon examining such discoidal slices of elder pith, they will be found to be perforated at pretty regular intervals by openings caused by cutting through the very thin cellulose walls of certain of the pith cells. The pith filter is, it is thus seen, mechanically produced by the help of the microtome. A good

[1] Edited by C. O. Whitman, University of Chicago.

supply of these little pith filters can be cut and kept in stock in a pill-box, ready for use at any time.

The next step is to take some ordinary good white filtering paper, cut into disks or squares about one inch in diameter. With a small drop of water on the end of a wooden toothpick, moisten a point at the centre of one of these paper disks or squares, so as to make a damp area just about the area of one of the disks of pith. Then take a wire 1–16 inch thick, heat one end, and with its help place on the paper disk or square some melted paraffine. This may be heated with the hot wire so as to saturate the whole of the paper disk or square, *except the central moistened spot*, which must be left unsaturated with paraffine.

The next step is to prepare a discoidal pad about one inch in diameter, composed of 10 to 20 superposed thicknesses of filter paper. Upon this the disk or square of filter paper, with all but the central spot saturated with paraffine, is superposed. I find that the ordinary extra large live-box or compressor, provided with a mica cover, with a round perforation of ⅝ inch in diameter in its centre, is an excellent device for holding the disk prepared with paraffine down upon the thick pad of filter paper. The accompanying figure, showing the complete ap-



paratus in vertical section, will perhaps make the arrangement of its parts clearer. The cap-ring *C* of the large-sized live box or compressor holds the perforated mica cover *m m* in place. This perforation should be a little larger than the disk of pith *e*, immediately below which lies the disk of filter paper *f*, which is saturated with paraffine except at its centre. Then follows the pad of several thicknesses of filter paper *P*. The mode of operation is as follows: Place *P* upon the glass disk *g* of the live box or compressor; then lay *f* upon *P*; then put the cap *C* with its centrally perforated mica cover *m m* in place and slip it

down over the drum *D*, so as to firmly hold *f* down upon *P*; then moisten the central exposed part of *f*, that is not saturated with paraffine, with a little water with a fine-nozzled pipette; then pick up one of the little disks of elder pith by one edge with a fine forceps and lay it down on the moist centre of *f*, with the convex side down, when it will at once flatten out and adhere to *f* and just neatly cover the central area not saturated with paraffine. The apparatus is now in readiness to begin operations.

Place a drop of water (*d*) swarming with animalcules from a vigorous culture of infusoria on *e*, when it will be found that the water will be rapidly drawn through *e* and *f* into *P* in the direction of the arrows. In this way several drops of water may have a large part of their animalcular population separated out and caught upon the surface of *e*. To kill the contents of *D* it is only necessary to add a little saturated corrosive solution or osmic acid, one per cent., with the help of a thin, slender wooden rod or toothpick to the drop. Enough of either of these killing and fixing agents can thus be added as a minute drop by simply thrusting the charged end of the wooden rod or toothpick *t* into the drop *d*. The animalcules are at once precipitated by the killing agents upon the upper surface of *e*, where, strange to say, they are caught and held in the meshes formed by the pith cells. The filter *e* may now be gently removed and lifted off *f* by means of a needle and forceps. With gentle handling I find that Ciliates will remain attached to *e*, and may be passed through a dozen reagents without their becoming detached, and that the pith disk, with its adherent objects, may be embedded in paraffine very readily by the watch-glass method.

Care should be exercised that the edges of the opening in *m m* do not come too close to the edge of *e*, else the water of the drop *d* will run off edgewise between *m* and *f*, and thus not pass through *e* alone. The paraffined portion of *f* should project a little beyond the free edges of *m*. Under such conditions the drop charged with organisms will round itself off as in the figure, and be kept from spreading by the greasy circular inner margin formed by the paraffine that saturates the margin of *f*. In lifting off *e*, raise its free edge slightly at one point with a needle; then catch the edge thus raised between the blades of a sharp-pointed forceps and transfer to a watch-glass containing 50 to 60 per cent. alcohol; then through the other solutions in succession.

Even orientation may be very easily effected by means of this method, either by sketching the outline of the whole disk and the position and direction of the axes of the very minute objects on it under a low power of the microscope, or else by shaving down the block after

the disk of pith is embedded, so as to make it nearly transparent and so as to show the shape of the adherent organisms through the semi-transparent block under a low power of the microscope. The proper cutting planes may now be marked or indicated on the margin of the block with lithographic ink or with a fine camel's-hair pencil with lamp-black and turpentine. If the latter method is resorted to, great care must be exercised in scraping or shaving down the block to keep the plane along which the paraffine is removed parallel to the surface of the disk *e*.

I have found it very easy to thus capture, hold, kill, dehydrate, stain, embed and cut *Paramœcium aurelia*. *Euplotes*, *Stylonychia* and *Halteria* will also adhere to these disks. *Halteria* is about the size of a white blood-corpuscle, and the fact that it may be entrapped and treated as here described shows what a wide range of utility is promised by this new method of capturing and embedding minute organisms. It will doubtless also be found useful in the study of very minute eggs and larvæ.

I find that these pith disks, loaded with their adherent organisms, may be mounted entire, and one in this way may get most instructive preparations, often with half a dozen genera on a single slide. Staining is also entirely under control, and any of the usual stains or anilines or combinations of them may be successfully applied and the action watched under the microscope and arrested at just the proper moment. With this method it has been found possible to cut 18 longitudinal serial sections and 50 transverse serial sections of *Paramœcium* with a thickness of 2.5 to 5 μ with the Ryder Microtome set to 1 or 2 teeth of the micrometer wheel.

The fixation of the sections on the slide may be effected by means of Gustav Mann's albumen method. Take the white of an egg (30 c. c.), shake up with 300 c. c. of water for 5 minutes; filter twice. Paint clean slides on one side with this mixture with the aid of a glass rod, and stand up on end to drain and dry; 200 or more slides may be thus prepared and dried ready for use. The albumenized side of the dry sides may be distinguished by breathing upon them. The sections are to be stretched by floating the ribbon of paraffin containing them on warm water (30°c.). Immerse one end of the albumenized slide in the water and float and arrange the sections on it albumenized side uppermost. Place slide on water bath to dry, when the paraffin may be removed with xylol or turpentine after which the staining may be done on the slide. This method of fixing sections to slide with albumen is much simpler and more practical than with Meyer's formula.

These pith disks may also be used to introduce into the serous cavities of higher organisms and left long enough to become filled with entrapped leucocytes or lymph cells. I anticipate that such a method would greatly facilitate the study of karyokinesis and its technique of staining in connection with wandering cells in wounds.

The novelty and simplicity of this new method, as well as its wide range of applicability, impels me to promptly offer it to my fellow-naturalists as a procedure that will in many cases be found to materially facilitate their work, especially the work of those engaged in the study of Protozoa, or of very minute ova or larvæ. A very simple form of this apparatus, for holding the filtering paper in position, is being made and offered for sale by Chas. Lentz & Sons, of Philadelphia.

Dec. 9th, 1894.

John A. Ryder.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

The American Society of Naturalists met in Baltimore at the Johns Hopkins University on Dec. 27th and 28th. The following were the officers: President, C. S. Minot; Vice-Presidents, William H. Dall, William Libbey, Jr., S. I. Smith; Secretary, W. A. Setchell; Treasurer, E. G. Gardiner; Committee at Large, H. F. Osborn, C. W. Stiles.

The Program was as follows: Thursday, December 27th, 2 P. M. Meeting in the Physical Laboratory for the following General Business: I. Reports of committees. II. Special reports. III. Recommendation of new members. IV. Discussion. Subject: Environment in its Influence upon the Successive Stages of Development and as a Cause of Variation. This was conducted by Prof. H. F. Osborn, Columbia College; Prof. E. B. Wilson, Columbia College; Prof. W. K. Brooks, Johns Hopkins University; Doctor C. Hart Merriam, U. S. Dept. of Agriculture. Thursday, 8 P. M., Illustrated lecture in Levering Hall, by Professor William Libbey, Jr., of Princeton University. Subject: Two Months in Greenland. Thursday, 9 P. M., The Johns Hopkins University received the members of the Society and their friends at a social assembly in McCoy Hall. Friday, December 28th, 9, A. M., General Session. I. Election of new members. II. Election of officers for 1895. III. Other business. Friday, 10 A. M., I. President's Address. Subject: The Work of Naturalist in the World, Prof. C. S. Minot, Harvard University. II. Annual Discussion. Subject: Laboratory Teaching of Large Classes. I. Introductory, Prof. Alpheus Hyatt, Boston Society of Natural History. 2. Zoological, Prof. H. C. Bumpus, Brown University. 3. Botanical, Prof. W. F. Ganong, Smith College. 4. General Discussion. Friday, 7.30 P. M., Annual Dinner of the Society of Naturalists and affiliated societies at The Stafford.

Officers for 1895 are President, Edward D. Cope, University of Pennsylvania; Vice-Presidents, Prof. William Libbey, Jr., Princeton; Prof. W. G. Farlow, Harvard; Dr. C. O. Whitman, University of Chicago; Secretary, Prof. H. C. Bumpus, Brown University; Treasurer, Dr. Edward G. Gardiner, Boston; Committee at large, Prof. Edmund B. Wilson, Columbia; Prof. W. H. Howell, Johns Hopkins.

The followed new members were elected: Dr. William Ashmead, United States Department of Agriculture; Dr. Severance Burrage,

Massachusetts Institute of Technology; Prof. H. E. Chapin, University of Ohio; Dr. J. E. Humphrey, Johns Hopkins University; Prof. Maynard Metcalf, Woman's College of Baltimore; Dr. W. H. C. Pynchon, Trinity College, and Dr. Norman Wyld, formerly assistant to Prof. Lloyd Morgan, in Bristol, England.

The American Morphological Society, met Dec. 27th and 28th at the Johns Hopkins University in Baltimore, Md. The following papers were read: Dr. C. W. Stiles, Larval Stages of an Anoplocephaline Cestode; Dr. W. A. Locy, Primitive Metamerism in Selachians, Amphibians and Birds; Dr. W. A. Locy, Note on the Homologies of the Pineal Sense Organ; Dr. E. B. Wilson, The Quadrille of the Centrosomes in the Echinoderm Egg; A second contribution to Biological Mythology; Dr. C. S. Minot, The Olfactory Lobe; Dr. C. S. Minot, The fundamental Difference between Animals and Plants; Dr. E. B. Wilson, The Polarity of the Egg in Toxopnenstes; Dr. A. Graf, The origin of pigment and the causes of the presence of patterns in Leeches; Dr. H. T. Fernald, Homoplasy as a Factor in Morphology; Mr. Seitaró Goto, The Anatomy of some Parts of Ectoparasitic Trematodes; Mr. A. P. Mathews, On the Morphological Changes in the Pancreatic Cell corresponding with Functional Activity; Mr. F. C. Kenyon, Anatomy and Relationships of Pauropida (read by Dr J. S. Kingsley): Dr. F. H. Herrick, Notes on the Biology of the Lobster; Prof. A. Hyatt, Remarks in the Bioplastology of Pecten; Dr. R. G. Harrison, Muscle Buds in the Pectoral fins of Teleosts; Dr. T. H. Morgan, The Minimum Size of Echinoderm Larvæ (read by Dr, E. A. Andrew).

The officers of the American Morphological Society for 1895 are: President, Dr. E. B. Wilson; Vice-President, Prof. W. B. Scott; Secretary and Treasurer, Dr. G. H. Parker; Members of Executive Committee from Society at large, Drs. T. H. Morgan and S. Watase.

American Physiological Society.—Seventh Annual Meeting, Baltimore, Md,, 1894 Thursday, December 27th, 9.30 A. M. The following general business was transacted. I. With regard to representation of this Society on a committee to decide the place of meeting of the Societies of Naturalists, Morphologists, Anatomists, and Physiologists, Pres.. H. P. Bowditch; II. Changes in the Tariff, E. T. Reichert, and J. W. Warren; III. The Teaching of Physiology in the Schools; W. H. Howell, and F. S. Lee; IV. A Physiological Journal, F. S. Lee, W. T. Porter, and H. H. Donaldson; III. A Subject for Discussion at the next Congress of American Physicians and Surgeons, The Council.

The following papers were read: G. M. Sternberg, "Explanation of Natural Immunity;" W. T. Porter, "Inhibition Hypothesis in the Physiology of Respiration;" S. J. Meltzer, "On Cardio-oesophagograms;" Mrs. C. L. Franklin, (Introduced by H. P. Bowditch), The Normal Defect of Vision in the Fovea;" T. E. Shields, (Introduced by W. H. Howell), "Demonstration of an Apparatus for the Plethysmographic Study of Odors, with Reports of Results;" W. T. Porter, "Hemisections of the Spinal Cord above the Phrenic Nuclei do not inhibit Thoracic Respiration;" G. T. Kemp, "Demonstration of a New Gas Pump for the Extraction of Blood-Gases;" Prof. H. A. Rowland, At the Physical Laboratory, "Exhibition of some New Forms of Galvanometers suitable for Physiological Use, with Remarks upon the Same."

Friday, December 28th, 9.30 A. M. J. G. Curtis, "Galen's Technical Treatise upon Practical Anatomy and Experimental Physiology;" G. Carl Huber, (Introduced by W. P. Lombard), "A Study of the Operative Treatment for Loss of Nerve Substance in Peripheral Nerves;" Franz Pfaff, (Introduced by H. P. Bowditch), "The active principle of Rhus toxicodendron and Rhus venenata;" F. S. Lee, "Further Experiments Upon Equilibrium in Fishes;" F. S. Lee, "Equilibrium in the Ctenophora;" G. P. Clark, (Introduced by F. S. Lee), "Equilibrium in the Crustacea;" W. T. Porter, "Acuteness of Vision in St. Louis Public School Children;" W. T. Porter, "The Weight of Dark-haired and Fair-haired Girls;" C. F. H. Hodge, (For Mr. C. C. Stewart), "A Means of Recording Daily Activity of Animals and the Influence upon it of Food and Alcohol;" C. F. Hodge, "The Influence of low Percentage of Alcohol Upon the Growth of Yeast." Visit to the New Anatomical and Histological Laboratories, the Hospital, etc. Election of New Members and other Business, at the New Anatomical Building. Reading of Papers and Demonstrations. J. J. Abel, "On the Occurrence of Diaethyl Sulphide in the Urine of the Dog, with a Demonstration of Reaction for the Detection of Alkylsulphides of the Series, $(C_N H_{2N} + {}_1)_2S$." J. J. Abel and T. B. Aldrich, "On the use of Trichloride of Acetonic Acid as an Anæsthetic for the Laboratory, with Some Account of its Fate;" J. J. Abel and A. C. Crawford, "Demonstration of Instances of Experimental Cachexia Thyreopriva in Dogs;" T. W. Mills, "Cortex of the Brain; (a) Localization; (b) Development of."

Council elected for 1894–95. H. T. Bowditch, President; R. H. Chittenden, W. H. Howell, W. T. Lombard; F. S. Lee, Secretary and Treasurer.

The Association of American Anatomists met in New York Dec. 28th and 29th, at the college of Physicians and Surgeons, under the following officers: Dr. Thomas Dwight, of Boston, Mass., President; Dr. B. G. Wilder, of Ithaca, N. Y., 1st Vice-President; Dr. F. J. Shepherd, of Montreal, Canada, 2d Vice-President; Dr. D. S. Lamb, of Washington, D. C., Secretary and Treasurer.

The following Papers and Discussions came before the Society. Friday, December 28th.—"The best arrangement of topics in a two years' course of Anatomy," by Dr. F. H. Gerrish, Bowdoin College. "History of the development of dentine," by Dr. Carl Heitzmann, New York City. "On the value of the nasal and orbital indices in anthropology," by Dr. Harrison Allen, University of Pennsylvania. "Loose characterization of vertebrate groups in standard works", by Dr. Burt G. Wilder, Cornell University. "The comparative anatomy of the cerebral circulation, with an exhibition of a series of anomalies of the circle of Willis" by Dr. Joseph Leidy, Jr., University of Pennsylvania. "Convolutions of the hemispheres of Elephas indicus;" by Dr. Geo. S. Huntington, College of Physicians and Surgeons, New York City. "Some muscular variations of the shoulder girdle and upper extremity, with especial reference to reversions in this region," by Dr. Huntington. Saturday, December 29th.—"On the significance of anomalies." Discussion opened by Dr. Thomas Dwight, Harvard Medical School. Followed by Dr. Frank Baker, University of Georgetown, D. C.; Dr. F. J. Shepherd, McGill University, Montreal; Dr. Burt G. Wilder, "Some anomalies of the brain"; Dr. Geo. S. Huntington; "Muscle variations in the Negro."

Officers for the years 1893–'94: Dr. Thomas Dwight, of Boston, Mass., President; Dr. B. G. Wilder, of Ithaca, N. Y., 1st Vice-President; Dr. F. J. Shepherd, of Montreal, Canada, 2d Vice-President; Dr. D. S. Lamb, of Washington, D. C., Secretary and Treasurer. Delegate to American Congress of Physicians and Surgeons: Prof. C. L. Herrick, of Granville, Ohio; Alternate: Dr. D. K. Shute, of Washington, D. C. Executive Committee: Dr. F. H. Gerrish, of Portland, Me.; Dr. Theodore N. Gill, of Washington, D. C.; Dr. Geo. L. Huntington, of N. Y. City and the President and Secretary, *ex officio*. Committee on Anatomical Nomenclature: Dr. Harrison Allen, of Philadelphia; Dr. Frank Baker, of Washington; Dr. Thomas Dwight, of Boston; Dr. Gerrish, of Portland; Dr. Burt G. Wilder, of Ithaca, Secretary.

Ohio Academy of Science.—This body met at Columbus, Dec. 27–8, 1894. The Officers were: President, F. M. Welester; Secretary; W. G. Tight. The following Papers were presented. 1. Preliminary List of Birds of Champaign County, J. A. Nelson. 2. Catalogue of the Odonata of Ohio, Part I, D. S. Kellicott. 3. Interesting and Little Mollusca of Ohio, V. Sterki. 4. Some New Points in the Structure of Dinichthys and Titanichthys, Albert A. Wright. 5. Additions to List of Coleoptera of Columbiana County, N. M. Hill. 6. Notes on the Bald Eagle, E. L. Mosely. 7. The Oaks of Ross County, Jane F. Winn. 8. An Improved Method of Determining the Laws of Acceleration in a Moving Body, Chas. E. Albright. 9. The Shaw Mastodon, Seth Hayes. 10. Preliminary Notes on the Distribution of Pronuba yuccasella, E. E. Bogue. 11. Glacial Till at Oberlin, Ohio, Lynds Jones. 12. On the Hitherto Unrecognized Horizon of Coal in Northeastern Ohio, E. W. Claypole. 13. A New Head of a Large Placoderm, Wm. Clark. 14. Grasses of Ashtabula County, Part I, Sara F. Goodrich. 15. Occurrence of the Gray King Bird in Ohio, Ernest W. Vickers. 16. Notes on the Variation of Liriodendron Leaves, Mrs. W. A. Kellerman. 17. Additions to the Bibliography of Ohio Botany, W. A. Kellerman. 18. On the Salina Group in Northeastern Ohio, E. W. Claypole. 19. Contributions to the Histology of the Order Nymphæaceæ as Represented in Ohio, E. M. Wilson. 20. Distribution of the Cranial Nerves of Cryptobranchus, J. H. McGregor. 21. A New Form of Ciliate Infusoria, V. Sterki. 22. Attractions for a Scientist in the Vicinity of Sandusky, E. L. Mosely. 23. An Other Miami Valley Skeleton, Including a Description of two rare Harpoons Found in Hamilton County, Sept. 22, 1894, Seth Hayes. 24. Notes on the Incubation of Turtle's Eggs, E. E. Bogue. 25. Five Birds New to Lorain County, Lynds Jones. 26. Unusual Nesting Site of the Pewee, E. W. Vickers. 27. A State Herbarium, W. A. Kellerman. 28. Some Notes on Collodion Imbedding, E. M. Wilcox. 29. Physalis viscosa, a Food Plant for Gelechia nigrimaculella, W. B. Hall. 30. Hygenic Dangers of Modern Civilization, E. L. Mosely. 31. Oligo-Nunk, Seth Hayes. 32. Insects New and Interesting at Oberlin, Ohio, Lynds Jones. 33. Summering of the Lark Sparrows in Mahoning Co. E. W. Vickers. 34. New Localities and New Plants for the Ohio Flora, W. A. Kellerman. 35. Notes on Sorex platyrhinus, E. W. Vickers. 36. Report on the Flora of Hocking Co., W. A. and K. F. Kellerman. 37. First List of Plants of Cedar Swamp, W. A. Kellerman and E. M. Wilcox. 38. The Development of the Watersheds of Ohio, W. G. Tight. 39. Entomological Notes for 1894 in Summit

County, E. W. Claypole. 40. Cetraria islandica. A Survivor of Glacial Times in Ohio, Edo Claassen. 41. The Phaenerogamic Exogenous Flora of Cuyahoga Co., Carl Krebs. 42. On a New Placoderm from the Ohio Shales, E. W. Claypole. 43. List of Birds Observed in Wayne County, H. C. Oberholser. 44. The Poisonous Plants of Ohio, Aug. D. Selby. 45. Two Cases of Buried Channels in the Licking River Valley, W. G. Tight. 46. The Pre-Glacial Channels of Paint Creek and North Fork, Gerard Fork. 47. Notes on Some New Introduced Plants, Aug. D. Seley. 48. List of Monocotyledonous Plants of Cuyahoga County, Edo Claassen. 49. Further Contribution upon Ohio Erysipheæ, Aug. D. Selby. 50. List of Cryptogamous Plants of Cuyahoga County, Edo Claassen. 51. The Department of Ceramics and Clay Working, and its Scope, E. Orton, Jr. 52. List of Monocotyledonous and cryptogamous Plants, being additions to the Lists 1 and 2 of the Nine Counties of Ohio, Edo Claassen. 53. Vitality of Vegetable Seeds, William R. Lazenby.

The officers of the meeting were: F. M. Webster, President, Wooster, Ohio. W. G. Tight, Secretary, Granville, Ohio.

The Indiana Academy of Science met at Indianapolis, December 27 and 28, 1894. The following were the Officers and Ex-Officio Executive Committee: W. A. Noyes, President; A. W. Butler, Vice-President; C. A. Waldo, Secretary; W. W. Norman, Assistant Secretary; W. P. Shannon, Treasurer; D. S. Jordan, T. C. Mendenhall, J. M. Coulter, O. P. Hay, J. P. John, J. L. Campbell, J. C. Branner, J. C. Arthur, Ex-Presidents.

The following Papers were read. Address by the Retiring President, Professor W. A. Noyes. 1. Some facts in the distribution of Gleditschia triacanthos and other trees Ernest Walker. 2. Propagation and protection of game and fish, I. W. Sharp. 3. Anthropology; the study of man, Amos. W. Bulter. 4. A new biological station and its aim, C. H. Eigenmann. 5. Transmission of impressions in spinal cord, G. A. Talbert. 6. Does high tension of electric current destroy life? J. L. Campbell. 7. The Purdue enigneering laboratory since the restoration, Wm. F. M. Goss. 8. Method of determining sewage pollution of rivers, Chas. C. Brown. 9. Psychological laboratory of Indiana Univ., W. L. Bryan. 10. Interesting deposit of alumina oxyhydrate, G. W. Benton. 11. Observations on glacial drift of Jasper Co., A. H. Purdue. 12. Concerning a burial mound recently opened in Randolph county, Joseph Moore. 13. Reversal of current in the Toepler Holtz electrical machine, J. L. Campbell. 14. A Florida shell mound U.

F. Click. 15. Note on rock flexure, Edward M. Kindle. 16. The alternate-current transformer with condenser in one or both circuits, Thomas Gray. 17. Elastic fatigue of wires, C. Leo Mees. 18. A warped surface of universal elliptic eccentricity, C. A. Waldo. 19. Accurate measurements of surface tension, A. L. Foley. 20. Effect of the gaseous medium on the electrochemical equivalent of metals, C. L. Mees. 21. Some new laboratory applicances in chemistry, H. A Huston. 22. Volumetric determination of phosphorus in steel, W. A. Noyes and J. S. Royse. 23. Action of ammonia upon dextrose, W. E. Stone. 24. Action of zinc ethyl on ferric chloride and ferric bromide, H. H. Ballard. 25. The sugar of the century plant, W. E. Stone and Dumont Lotz. 26. Camphoric acid, W. A. Noyes. 27. Action of potassium sulfhydrate upon certain aromatic chlorides, Walter Jones and F. C. Scheuch. 28. A new phosphate, H. A. Houston. 29. Dip of the Keokuk rocks at Bloomington, Ind., Edward M. Kindle. 30. Structural geologic work of J. H. Means in Arkansas, J. C. Branner. 31. Wave marks on Cincinnati limestone, W. P. Shannon. 32. Correlation of Silurian sections in eastern Indiana, V. F. Marsters and E. M. Kindle. 33. Some new Indiana fossils, C. E. Newlin. 34. Extinct fauna of Lake county, T. H. Ball. 35. Strepomatidæ of the Falls of the Ohio, with their synonymy, R. Ellsworth Call. 36. Streams of southeastern Indiana, with list, H. M. Stoops. 37. The swamps of Franklin county, H. M. Stoops. 38. Water cultures of indigenous plants, D. T. MacDougal. 39. Working shelves for botanical laboratory, Katherine E. Golden. 40. New apparatus for vegetable physiology, J. C. Arthur. 41. Collections of plants made during the year, M. B. Thomas. 42. The flowering plants of Wabash county, A. B. Ulrey and J. N. Jenkins. 43. Revision of the phanerogamic flora of the state, Stanley Coulter. 44. Report of progress of the botanical division of the State Biological Survey, L. M. Underwood. 45. Value of seed characters in determining specific rank in the genus Plantago, Alida M. Cunningham. 46. Additions to the fish fauna of Wabash county, W. O. Wallace. 47. Notes on the reptilian fauna of Vigo, W. S. Blatchley. 48. Preliminary list of birds of Brown co., Edward M. Kindle. 49. The birds of 1893, Amos W. Butler. 50. Some notes on the blind animals of Mammoth Cave, with exhibition of specimens, R. Ellsworth Call. 51. The batrachians and reptiles of Wabash co., W. O. Wallace. 52. On the occurrence of the whistling swan (*Olor columbianus*) in Wabash county, A. B. Ulrey. 53. Birds of Wabash county, A. B. Ulrey and O. W. Wallace. 54. Birds observed in the Sawtooth mountains, B. W. Evermann and J. T. Scovell. 55. Ani-

mal parasites collected in the state during the year 1894, A. W. Bitting. 56. Angling in the St. Lawrence and Lake Ontario, Barton W. Evermann. 57. Indiana mammals, Amos W. Butler. 58. Mimicry in fishes, W. J. Moenkhaus. 59. Variation in Leuciscus, C. H. Eigenmann. 60. The redfish of the Idaho lakes, B. W. Evermann and J. T. Scovell. 61. Observations upon some Oklahloma plants, E. W. Olive. 62. Rediscovery of Hoy's white fish or moon-eye (*Argyrosoma hoyi*), Barton W. Evermann. 63. Saxifragaceæa of Indiana, Stanley Coulter. 64. The range of the blue ash, W. P. Shannon. 65. Plant products of the U. S. Pharmacopœa (1890), John S. Wright. 66. Noteworthy Indiana phanerogams, Stanley Coulter. 67. Methods of infiltrating and straining *in toto* the heads of Vernonia, E. H. Heacock. 68. Embryology of the Ranunculaceæ, D. M. Mottier. 69. Certain chemical features in the seeds of Plantago virginiana and P. patagonica, Alida M. Cunningham. 70. Root system of Pogonia, M. B. Thomas. 71. Salt-rising bread, Katherine E. Golden. 72. An increasing pear disease in Indiana, L. M. Underwood. 73. Notes on the Florideæ, Geo. W. Martin. 74. Measurement of strains induced in plant curvatures, D. T. MacDougal. 75. The stomates of Cycas, Edgar W. Olive. 76. The buckeye canoe of 1840, W. P. Shannon. 77. Embryo-sac of Jeffersonia diphylla, Frank M. Andrews. 78. Cell structure of Cyanophyceæ, Geo. W. Martin. 79. Some notes on the amoeba, A. J. Bigney. 80. Variations of Polyporus lucidus, L. M. Underwood. 81. Preliminary account of the development of Etheostoma cœruleum, A. B. Ulrey. 82. Embryology of the Cupuliferæ, D. W. Mottier. 83. Embryology of the frog, A. J. Bigney. 84. Variation in Etheostoma, W. J. Moenkhaus. 85. Blood corpuscles of very young human embryo, D. W. Dennis. 86. Poisonous influences of some species of Cypripedium, D. T. MacDougal. 87. Development of sexual organs of Cymatogaster, C. H. Eigenmann. 88. The vegetation house as an aid in research, J. C. Arthur. 89. The proposed new systematic botany of North America, L. M. Underwood.

The officers elected for the ensuing year are: President, A. W. Butler, Brookville, Ind.; Vice-President, Stanley Coulter, La Fayette, Ind.; Secretary, John S. Wright, care of Eli Lilly and Co., Indianapolis, Ind.; Assistant Secretary, A. J. Bigney, Moore's Hill, Ind.; Treasurer, W. P. Shannon, Greensburg, Ind.

Iowa Academy of Science, met at Des Moines, Iowa, Decembe 27 and 28, 1894.—The officers of the Academy are: President, L. W. Andrews; First Vice-President, H. W. Norris; Second Vice-President,

C. R. Keyes; Secretary and Treasurer, Herbert Osborn; Ex-officio, L. W. Andrews, H. W. Norris, C. R. Keyes, Herbert Osborn; Elective, C. C. Nutting, M. F. Arey, W. S. Hendrixson; Librarian, C. R. Keyes.

The following papers were read: 9 A. M., Business Session of Council. 10 A. M., J. E. Todd and Foster Bain: 1. Inter-Lœsial Till near Sioux City; H. Foster Bain: 2. Pre-Glacial Elevation of Iowa; 3. The Central Iowa Section of the Mississippian Series; Charles R. Keyes: 4. Secular Decay of Granitic Rocks; 5. Structure of Paleozoic Echinoids; 6. Opinions Concerning the Age of the Sioux Quartzite; 7. Illustrations of Glacial Planing in Iowa; Arthur J. Jones: 8. Record of the Grinnell Deep Boring; 9. The Topaz Crystals of Thomas Mountain, Utah; A. G. Leonard: 10. The Lansing Lead Mines; F. M. Fultz: 11. How Old is the Mississippi? 12. On the Formation of the Flint Beds of the Burlington Limestones; 13. Coincidence of Present and Pre-glacial Drainage Systems in Extreme South-eastern Iowa; 14. Extensions of the Illinois Lobe of the Great Ice Sheet into Iowa; 15. Glacial Markings in South-eastern Iowa; S. Calvin: 16. The Maquoketa Shales in Delaware County, Iowa; 17. On Some Supposed Devonian Outliers in Delaware County, Iowa; William H. Norton: 18. On the Occurrence of *Megalomus canadense* in the LeClaire Beds at Port Bryon, Ill.; 19. Geological Section of Y. M. C. A. Artesian Well at Cedar Rapids, Iowa. 1 P. M. Report of Secretary and Treasurer. Report of Librarian. Report of Committees. 2 P. M. L. W. Andrews: 20. President's Address, Recent advances in the Theory of Solutions; C. C. Nutting: 21. Report of Committee on State Fauna; W. S. Franklin: 22. A New Method of Studying the Magnetic Properties of Iron; 23. On the Design of Transformers and Alternating Current Motors; 24. Note on a Phenomenon of Diffraction in Sound; W. S. Windle: 25. A. Kymograph and Its Use; A. C. Page: 26. The Volatility of Mercuric Chloride; N. E. Hansen: 27. Notes on Applying Pollen in the Cross-breeding of Plants. 9 A. M. Business Meeting. 9.30 A. M. C. F. Curtiss: 28. Changes that Occur in the Ripening of Indian Corn; G. E. Patrick: 29. Methods of Soil Analysis; Floyd Davis: 30. The Coal Supplies of Polk County, Iowa; D. B. Bisbee: 31. A Study of the Nitrogen Compounds of the Soil; W. H. Heileman: 32. A Chemical Study of Honey; A. A. Bennett: 33. Notes from the Chemical Laboratory, Iowa Agricultural College, 1894. 1.30 P. M. F. C. Stewart: 34. Effects of Heat on the Germination of Corn and Corn Smut; C. W. Mally: 35. A General Discussion of the Family Psyllidæ, with

Descriptions of New Species found at Ames, Iowa; Alice M. Beach: 36. New Species of Thripidæ; Herbert Osborn and F. Atwood Sirrine: 37. Studies of Migration of Certain Aphidideæ; F. Atwood Sirrine: 38. Description of a Species of Aphid Occurring on Carex; L. H. Pammel and Alice M. Beach: 39. The Pollination of Cucurbits—by Title; Alice M. Beach: 40. Notes on the Pollination of Some Flowers; L. H. Pammel: 41. On the Migration of Some Weeds; 42. Notes on Fungus Diseases of Plants at Ames, Iowa, 1894—by Title; 43. Notes on the Flora of Western Iowa—by Title; L. H. Pammel and O. H. Pagelsen: 44. The Action of Antiseptics and Disinfectants on Some Micro-organisms; L. H. Pammel and Robert Combs: 45. Notes on a Micrococcus which Colors Milk Blue; Emma Sirrine: 46. On the Structure of the Testa of Polygonaceæ: Cassie M. Bigelow: 47. A Study of the Glands in Hoptree (*Ptelea trifoliata*). T. Proctor Hall: 48. Graphic Representation of the Properties of the Elements; 49. Strata Passed in Sinking a Well at Jidney; Arthur C. Spencer: 50. Notes on the Minerals of Webster County; A. H. Conrad: 51. Some Notes on the Reptiles of Southeastern Iowa; 52. Bones Found in a Cave in Louisa County; 53. Mastodon and Mammoth Remains in Southeastern Iowa; E. H. Lonsdale: 54. Cement Clays in Iowa; 55. Conclusions as to the thickness of the Upper Carboniferous in Southwestern Iowa; R. Ellsworth Call: 56. A Geograpical and Synonymic Catalogue of the Unionidæ of the Mississippi Valley—by title.

The officers elected for 1895 are: H. W. Norris, President; C. R. Keyes, First Vice-President; T. Proctor Hall, Second Vice-President; Herbert Osborn, Secretary and Treasurer; H. Foster Bain, Librarian; N. E. Hansen, T. H. McBride, and W. H. Norton, elective members of the executive council.

Des Moines Academy of Science.—Officers elected; Floyd Davis, recently of the New Mexico School of Mines, as President and J. Christian Bay, State Bacteriologist, as Secretary.

Boston Society of Natural History.—Dec. 5th, the following papers were read: Mr. Outram Bangs: Color variation in the geographical races of the white-footed mouse. Specimens were shown. Dr. C. B. Davenport: Bibliographic reform. Dr. G. H. Parker: Migration of pigment in compound eyes. December 19, Prof. W. M. Davis: Notes on certain European rivers. Stereopticon views were shown. January 2d, Dr. J. Walter Fewkes: The new fire ceremony at Walpi. Dr. Fewkes illustrated the aboriginal methods of fire-making.

Samuel Henshaw, *Secretary.*

The Biological Society of Washington.—December 15. The following communications were made: Mr. Charles T. Simpson, On the Validity of the Genus *Margaritana*. Prof. C. V. Riley, Some Interesting Results of Injury to Tree. Dr. Erwin F. Smith, The Last Phase of the Root Tubercle Disease. Jan. 12, 1895.—The paper of the evening was: The Plant Individual in the Light of Evolution, By Prof. L. H. Bailey of Cornell University. Frederic A. Lucas, *Secretary*.

SCIENTIFIC NEWS.

Sir Charles T. Newton, the eminent Archæologist, died Nov. 28.

The Medals of the Royal Society for 1894, were awarded as follows: Copley Medal to Dr. Edward Frankland; Rumford Medal to Professor Dewar; Royal Medals to Professor J. J. Thompson and Professor Victor Horsley; Davy Medal to Professor Peter S. Cleve; Darwin Medal to Right Hon. T. H. Huxley.

Dr. J. Walther has been appointed Professor of Geology and Paleontology at the University of Jena; and Dr. König Professor of Zoology at the University of Bonn.

A Government Museum for Natural History and Ethnology has been established at Para, Brazil, with Dr. Emil A. Goldi as first Director.

Mr. Robert T. Hill of the U. S. Geological Survey has gone to Panama.

Dr. H. C. Mercer of the Archeological Museum of the University of Pennsylvania, has gone to Yucatan.

Dr. Robert H. Lamborn died suddenly of rheumatism of the heart in New York, Jan. 14th. Dr. Lamborn was born at Kennett Square, Chester Co., Pa. in 1836. He graduated at the University of Giessen, and took the degrees of Ph. D. He wrote treatises on the metallurgy of silver, and of copper, and on Mexican Native Painters. He acquired a fortune in connection with various enterprises in the far West, especially by The Denver and Rio Grande R. R., the Mexican National R. R. etc. Of late years he was especially interested in Archeology, and he rendered invaluable assistance to various institutions in this direction. He also offered considerable prizes on two occasions, first for the best essay on the cultivation of dragon-flies for the destruction of musquitoes; and second, for the best essay on the characteristics of the best type of citizen. At the time of his death he was engaged on a research as to the part played in modern civilization by the Society of Friends, of which body he was born a member.

Mr. W. H. Ballou has sent to the Legislature of New York a draft of a bill creating a zoological park commission for the City of New York, and providing for the establishing of a zoological garden in Bronx or Pelham Bay Parks.

The Smithsonian Table at the Naples Station has been awarded to Professor T. H. Morgan for the dates Nov. 9, 1894 to May 8, 1895, incl., and to Prof. Herbert Osborn for the time May 9, 1895 to October. 8, 1895.

The table will be vacant from October 9, 1895 to June 8, 1896. Applications for it may be filed at any time with Professor Langley, Secretary of the Smithsonian Institution.

The next meeting of the Committee to consider applications will be on April 9, 1895.—W. C. STILES, Sec. Comm.

The weekly journal SCIENCE will be published after January 1st, under the direction of an editorial committee in which each of the sciences is represented by a man of science who is at the head of his department. The committee is constituted as follows: *Mathematics*, Prof. S. Newcomb (Johns Hopkins University and Washington); *Mechanics*, Prof. R. S. Woodward (Columbia College); *Physics*, Prof. T. C. Mendenhall (Worcester); *Astronomy*, Prof. E. C. Pickering (Harvard University); *Chemistry*, Prof. Ira Remsen (Johns Hopkins University); *Geology*, Prof. J. LeConte (University of California); *Physiography*, Prof. W. M. Davis (Harvard University); *Paleontology*, Prof. O. C. Marsh (Yale University); *Zoölogy*, Prof. W. K. Brooks (Johns Hopkins University), Dr. C. Hart Merriam (Washington); *Botany*, Prof. N. L. Britton (Columbia College); *Physiology*, Prof. H. P. Bowditch (Harvard University); *Hygiene*, Dr. J. S. Billings (Washington); *Anthropology*, Prof. D. G. Brinton (University of Pennsylvania), Major J. W. Powell (Washington); *Psychology*, Prof. Cattell (Columbia College).

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The following may be mentioned as having contributed to the Volume for '94.

Dr. D. G. Brinton, Rev. Wm. M Beauchamp, Prof. A. F. Chamberlain, Mr. James Deans, G. O. Dorsey, Dr. J. Walter Fewkes, H. C. Mercer, Mrs. Zelia Nuttall, C. Staniland Wake, Dr. Wm. Wallace Tooker, Dr. Cyrus Thomas. The Magazine during '95 will embrace different departments, and the following gentlemen will have charge and report all explorations and discoveries:

Rev. Wm. C. Winslow, D. D., L. L. D., Egypt.
Prof. T. F. Wright, Explorations in Palestine.
Henry W. Haynes, Paleolithics and European Archaeology.
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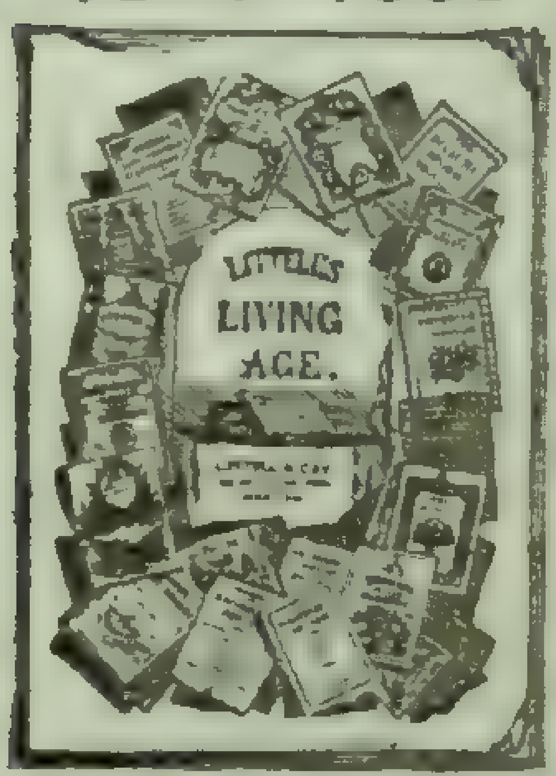

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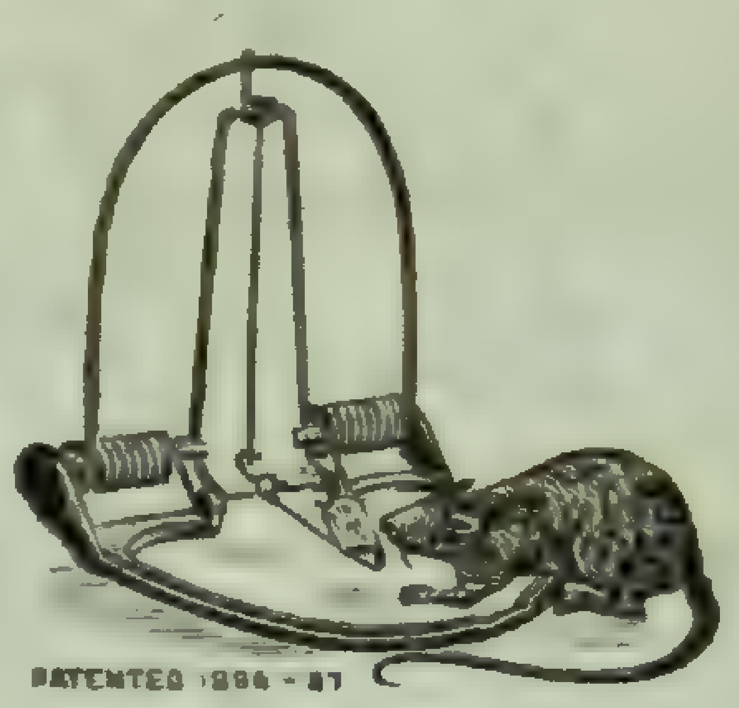

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Vol. XXIX. MARCH, 1895. No. 339

CONTENTS.

PAGE.

IN THE REGION OF THE NEW FOSSIL, DÆMONELIX. (Illustrated.) . *Frederick C. Kenyon.* 213

THE COLD SPRING HARBOR BIOLOGICAL LABORATORY. (Illustrated.) . . . *H. W. Conn.* 228

MINOR TIME DIVISIONS OF THE ICE AGE. *Warren Upham.* 235

THE SKUNK AS A SOURCE OF RABIES. *W. Wade.* 242

THE CLASSIFICATION OF THE LEPIDOPTERA. (Illustrated.) . . . . . *Vernon L. Kellogg.* 248

RECENT LITERATURE—The Glacial Nightmare and The Flood—Life Histories of North American Birds—Geology of the Coastal Plain of Alabama—Thirteenth Annual Report of the U. S. Geological Survey for 1891–'92. Part II—Reports of the Geological Survey of Arkansas for 1891 and 1892. 258

RECENT BOOKS AND PAMPHLETS. 261

GENERAL NOTES.

Geography and Travels.—African Volcanoes. 264

Mineralogy.—New Instruments. Goniometer with two Graduated Circles—Universal Goniometer—Miers's Inverted Goniometer—New Goniometer Lamp—Darkening Attachment for the Goniometer—Lecture Microscope—Czapski's Ocular—Klein's Lens with Micrometer. 266

Geology and Paleontology.—Relations of Devonian and Carboniferous Faunæ—Characters of Glossopteris—Geological History of the West Indies—Fossil Mammals of the Lower Miocene White River Beds—Geological News. 270

Botany.—Some Botanical Collections—Some Recent Botanical Papers. 274

Zoology—The Central Nervous System of Teleosts—New Deep Sea Fishes—Preliminary Notes on the Osteology of the North American Crotalidae—Zoological News—Pisces—Mammalia. 278

Embryology—Sexually Produced Organisms without Maternal Characters?—Double Monsters—Fusion of Blastomeres—Temperature and Development—A Problematical Structure in a Mammal—Development of Scyphomedusæ—Blastomeres of Medusæ—Development in Rarified Air. 286

Psychology—The Present State of Psychology 292

Archeology and Ethnology—The Contention of Mr. J. D. McGuire—The Results of Cave Exploration in Germany. 298

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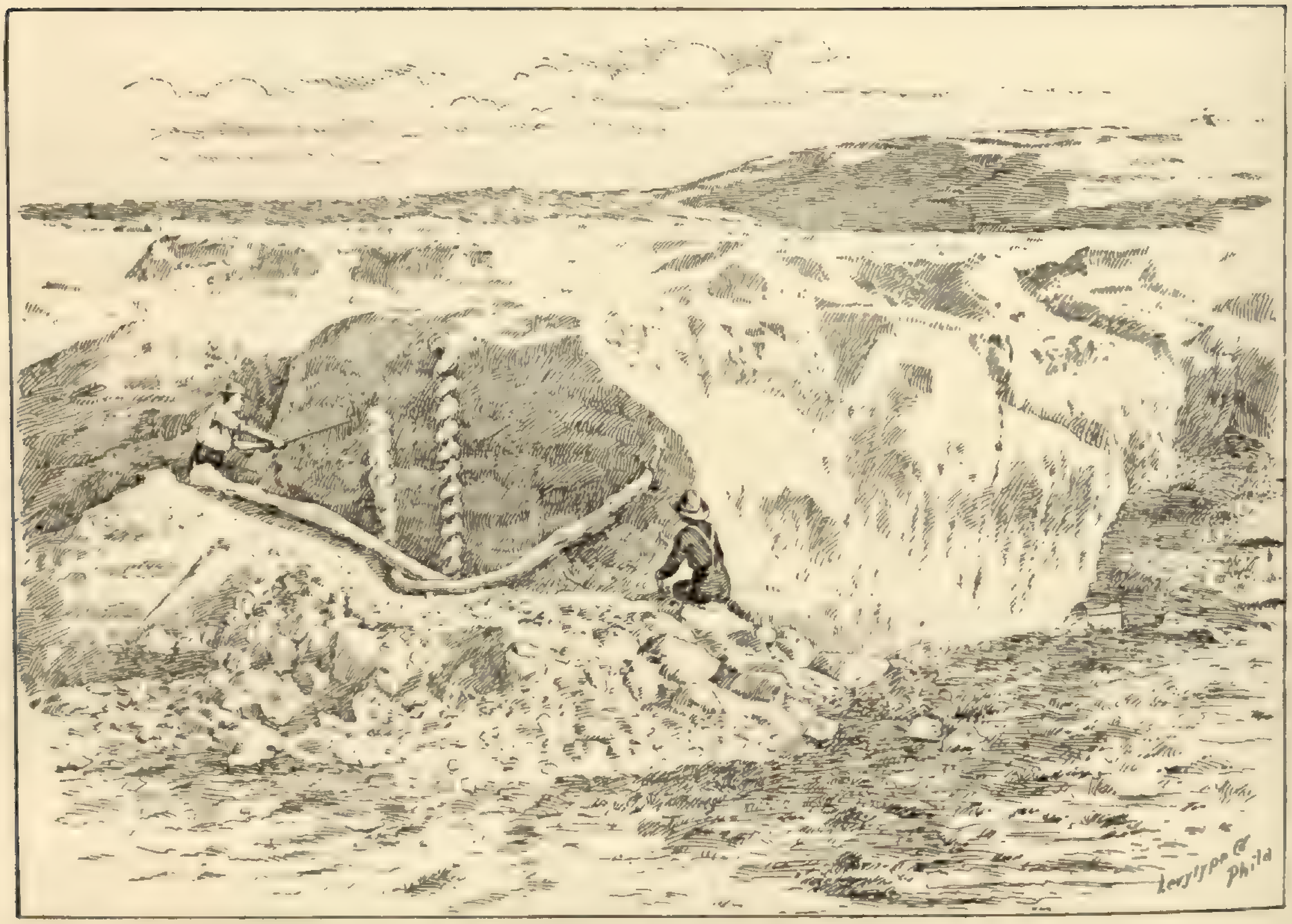

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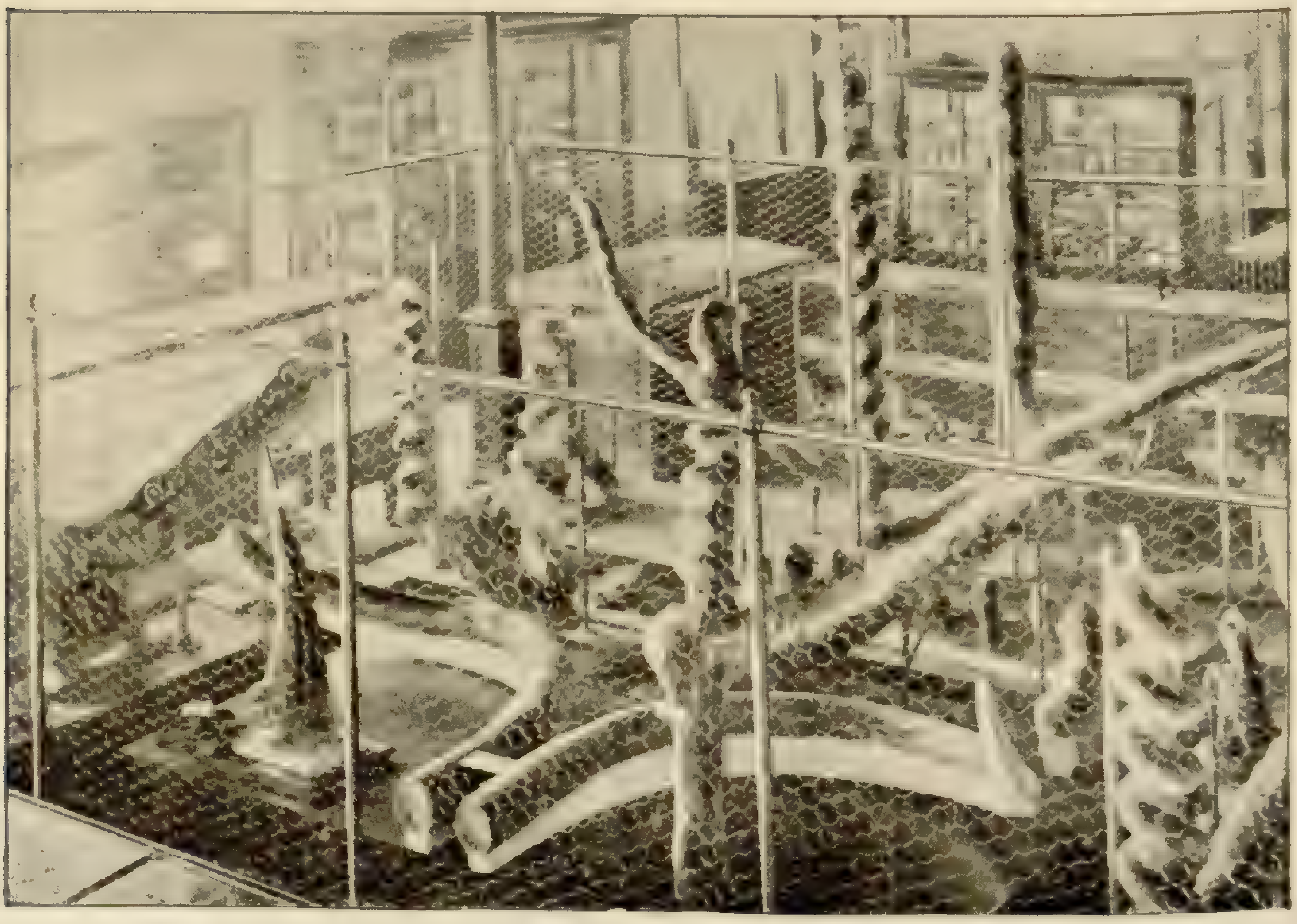


Dæmonelix in the Museum at Lincoln, Nebraska.

THE

AMERICAN NATURALIST

VOL. XXIX. March, 1895. 339

IN THE REGION OF THE NEW FOSSIL, DÆMONELIX.

BY FREDERICK C. KENYON.

As important as they have been to the paleontologist in yielding perfect remains of the strange looking mammals of Miocene times, the Bad-lands of Nebraska and South Dakota with the neighboring region have received very little attention outside of some of the early government surveys. From the common geological text books one learns that they are in the bed of a Miocene lake, which like several others of the same times on the other side of the Rocky Mountains, received the bones of the animals living on the surrounding shores and buried them under a great mass of sediment. Nearly all of what little has been written has been taken from the writings of Hayden and the notes of Dr. Evans, neither of whom possessed a camera to enable them to give their readers an adequate pictorial idea of the wonderful region that they describe in a few glowing words.

During the summer of 1893 it was my good fortune to spend several weeks in this region in a party that, in consequence of the generosity of the president of the board of regents of the University of Nebraska, had become known as the "Morrill Geological Expedition." Our main object was to study and collect the strange new fossil made known to science during

the previous spring by Professor E. H. Barbour as Dæmonelix, but known for some time to the cowboys and ranchmen of the region where it occurs as "the devil's corkscrew" and "fossil worm."

About noon of the day following our departure from Lincoln we found ourselves in the little town of Harrison, near which Professor Barbour had obtained the one specimen that he had brought back to the University the year before. This is the county seat of Sioux County, which forms the northwestern corner of Nebraska. It is not different from the many small towns that one finds on the prairies of the far west. We found a brick court house, a church, a school-house, a hotel, the almost invariable liquor saloon, several stores, and some two dozen or more dwellings. During Harrison's administration the town had received its name and had had its western boom as the chief and only commercial center of some 300 square miles of territory, constituting Sioux County and supporting, according to the last census, less than 2500 inhabitants. During the summer of 1890 Sioux County, in common with a large number of other Nebraska counties, suffered terribly from drouth. Many of the settlers were compelled to abandon their newly made homes to save themselves from ruin. Among those left behind unable to get away, there was intense suffering. During the succeeding winter many private donations of coal and provisions were sent them by the more favored farmers of the eastern counties. In this work of charity even the State was called upon to lend a hand. But this year the few inches of rain that had fallen had put an entirely different aspect upon everything. Many of the deserted homes that might have been seen in the western counties during the spring of 1891 were now reoccupied and everything looked hopeful. About Harrison the landscape was enlivened by innumerable bright colored flowers. Chief among these were many species of *Astragalus* and related genera of leguminous plants. Here and there could be seen the bright colored spikes of the "loco-weed," rendered famous on western prairies by the baneful effect it has upon every horse unlucky enough to eat it. The animals are not killed, but are made so crazy

that they become unmanageable. Throughout the spring and early summer months there is a wonderful profusion of flowers. As fast as one species finishes its blooming period another takes its place; in fact, whatever one sees is but an earnest of what might be, were rain less uncertain, or could the land be irrigated. But for irrigation, since the greater part of the county is so high above the three small streams that drain it, dependence must be placed upon artesian wells, which would cost more than the average ranchman can afford to pay. The consequence is that one seldom meets with a settler anywhere in the county except in the cañons, where water may be obtained with little trouble.

In early times there may have been over a broad strip of country, west of the Missouri River, a dearth of vegetation that made the name of Great American Desert much more appropriate than at present. It is not unlikely, in fact, it is very probable, that Fremont, when he gave origin to the term, was deceived by the aspect produced by the low creeping buffalo grass. In the eastern part of Nebraska the buffalo grass had almost entirely given place to the blue-stem grasses when the state was admitted into the Union. There has been a constant westward movement of vegetation, though it is doubtful whether, outside of man's influence, it has been as rapid as some of the early writers would have us believe. Still, there is an impression constantly met with among the older settlers that there has been a great change in both climate and vegetation. The territory north of the Platte River, known as the "Sand-hills," is said to have been once entirely bare, but it is now covered with grasses. The yearly amount of moisture precipitated is believed to be, on the whole, steadily increasing. In the extreme western part of the state, in early territorial times, one might sleep in the open air without one's blankets being dampened by a single drop of dew. Now heavy dews fall all over the state.

This constant change of climate is commonly accounted for by the western settler by the breaking up of the prairie sod and the cultivation of the soil, which certainly has enabled much of the rain that has fallen to be retained instead of run-

ning off through the creeks to the Missouri River. Occasionally one meets with a very ludicrous explanation; and not the least among the ludicrous is the idea of electrical disturbances produced by iron rails and barbed wire fences. When there were few fences, and the Union Pacific was about the only railroad in the state, the disturbances were said to be produced by the rails, later the barbed wire fences played the chief part in precipitating atmospheric moisture. In reply to such ignorance and credulity, which, by the way, makes it possible for the early lightning rod swindler or his kind to turn rain maker, about all that need be said is that judging from reports from the various prairie states during the present summer, a great many fences must have been taken down.

Near Harrison and southward the surface of the country rises and falls in long, sometimes "rolling hills." From an altitude of 4871 feet at Harrison it rises to considerably over 5000 on the highest point of Pine Ridge northwest of the town and on the western edge of the state. Through this high table land deep cañons have been worn by the White and Niobrara Rivers on the south, while on the north, the deep, broad valley of Hat Creek has been cut out by an insignificant tributary of the south fork of the Cheyenne. Along the northern edge of this table land and along the edges of that forming the divide further eastward between the White and Niobrara Rivers, may be seen numerous clumps of the western or yellow pine which have given the name to the ridge. Back into the ridge have cut numerous deep cañons the branches of Hat Creek. In these, cottonwoods, box elders, ash, elms, willows, and other trees find enough moisture and protection to flourish. In their upper courses they sometimes break up into numerous deep and precipitous ravines, and at the extreme heads of these are found those eroded places that present the appearance of, and are known as "blow outs." In some cases their lack of connection with the ravines leaves no room for doubt that they can be anything else than wind-formed excavations.

It is in these "blow outs" and ravines that the peculiar "cork-screw" fossil is found. In some cases they may be seen

so thickly strewed about as to give the idea of their having formed a veritable forest. Very few other fossils are found with them. The celebrated fossiliferous or Bad-land formation, is far below.

The more perfect of these corkscrew-like fossils consist of an invariably perpendicular spiral, and, running away and upward from its base, a great, log-like stem. The greatest number of whorls that we found in a single specimen was thirteen, which rose to a height of more than eight feet. The stem of this specimen was some thirteen feet long. Sometimes "screws" may be found without a stem, sometimes the spiral, turning either to the right or left, may be broad and open, at others it may be very close. Now and then a specimen may be found in which there is a central pole-like portion around which the spiral turns. More frequently there is found only a few whorls and a short stem.

At a little lower level than that at which we found the finest specimens, very irregular and prostrate forms are common. In the banks of the ravines they look like so many large tree roots exposed by erosion. In one instance a screw with about three whorls was found at this lower level, which, unlike any other that we had seen, ended below in two roots that branched off from one another at a broad angle.

These strange fossils consist of a white substance a little harder than the semi-petrified calcareous sandstone in which they occur, and, when exposed by wind or water, stand out in bold relief against the cliffs or walls of the ravines and "blow outs." In some cases they project like tree stumps, and, strewn about among these, fragments from a few inches to several feet in length are common. The surface of both spiral and stem may vary from fairly smooth to rough and knotty. Often small filaments are broken off in digging, but as sheet-like layers of similar hardness and appearance are frequently broken through, it may be doubtful whether they really belong to the fossil. Sometimes the knots, or even the whole surface, made up of innumerably fine filaments, may look like that of a hard and compact sponge. In the broken cross section an external whitish ring is presented, surrounding a

great core of a color similar to that of the surrounding rock. This is not quite as hard as the external white ring and often shows sections of large white tubular structures.

What this so-called "corkscrew" may be may remain in mystery for some time to come. The sponge-like appearance of some of the specimens seemed to proclaim it a gigantic fresh water sponge. But microscopic examination brought forth no evidence of the spicules that one would expect. All that could be found of an organic nature was in one or two instances a few plant cells. The presence of these, however, might be explained as living cells of rootlets that had worked into the fossil and in no way belonged to it. In one instance a nearly entire skeleton was found in a stem near its junction with its spiral and suggested the idea that our fossil might be nothing more than the core of a rodent hole. Still another supposition was that it is only a concretionary formation. The peculiar and regular form, lack of concretionary structure, and widespread occurrence at once throws aside the last supposition. The regularity of the spiral, the "pole"-like structure in some of the spirals, the fact that the spiral tapers from top to base, and sometimes may have tapering root-like ends, and finally the presence of tubular structures within the spiral and stem, demonstrate the untenability of the "burrow" idea. If the "cork screw" was the underground stem and root of some aquatic plant it becomes very difficult to explain the presence of the skeleton. If it is supposed to be of a sponge-like nature and growing above the lake bed, the presence of the skeleton may readily be accounted for. It might become entangled in the growing sponge mass and surrounded, just as any pebble or shell may be found to be covered by some existing sponges.[1]

The uniformity with which the "stem" occurs points to a mode of growth that finds its analogy among some of the

[1] Since this paper was written, I have seen a paper by Prof. Barbour giving the last results of his studies. Sections have been made from all parts of the fossil and from numerous specimens with the uniform result of demonstrating the presence of plant cells. These have an average size of 35 to 50 by 16 microns and an evidently parenchemyous nature. Since no others are found, the structure must have been very low in the scale of life.

See University Studies, University of Nebraska, July, 1894.

lower plants and the grasses. This would suppose that a stem starts out from the side, or perhaps the top of a screw and descending downward after awhile sends up a new screw. Then if the connection with the parent screw should be lost through decay, or if the parent screw itself should decay, each "screw" would be left independent. The fact that the distal end of the stem is invariably very rotten lends some weight to this supposition. As yet, no two specimens have been found with any other connection than that produced by crowding.

After three weeks of corkscrew digging in the vicinity of Harrison, we decided to make a short trip southward to the Niobrara, where, we were informed, screws of enormous size, some with tree-like tops, might be found. With the two teams that we had managed to hire in the town, we followed the trail over the prairie to the southeast. Once or twice we passed a lonely "claim," but when these and Harrison had become hidden by the hills behind us, we could look for miles around without seeing a sign of human life. From time to time a jack rabbit would be started and be seen bounding away from our path. The only sounds that we heard, not made by ourselves, were the songs of the black finch (*Calamospiza bicolor*) which was, in fact, very musical. Late in the afternoon we sighted the high hills south of the Niobrara Valley, and towards evening came upon what appeared to be the head of a cañon running down into it. On the lower banks of this a great number of concretions of varying shapes and sizes were strewn about. In general they were oval, and from an inch to several inches through. With the aid of a sledge a number of these were broken off and packed in the wagons. On breaking them they were found to be made up of a great number of thin lamellæ of sandstone, which were alternately dark and light. They lay on the ground as they had been exposed by the erosion of the banks, and were attached to the rock and to one another by small necks.

While busy cracking concretions we were surprised by the ominous aspect of a cloud that had seemed a little while before to be going by, but now was fast coming straight over us. We had barely spread the canvas wagon-covers over the

bows before great drops of rain began to pelt us. In a moment the rain fairly poured down, and we were alternately blinded and deafened by the sharp crackling lightning and the heavy claps of thunder.

If our ribby horses had needed a whip before, they now set off most willingly before the storm. Soon we found ourselves at the edge of the bluff bordering the Niobrara Valley on the north. The valley presented a fine spectacle in the storm. It is not wide, not more than a mile. On the opposite side we could see the steep high bordering hills, and near them the small stream winding through the nearly level valley. By its side the log house of James Cook and his spacious red barns appeared through the misty veil. This was the Agate Springs ranch, whither we had been requested to come to see the giant corkscrews with tree-like tops. Down the declivity before us we went with tightened brakes, which were now and then rendered nearly useless by the slipperiness of the road. We finally reached the level below without mishap, and a little later pulled up before the friendly shelter of the red barns. Shortly after our arrival the rain ceased and we found ourselves in the presence of Mrs. Cook.

Mr. Cook was absent, but during that evening and that of the day following we were most agreeably entertained by Mrs. Cook and Mr. Cook, her brother-in-law. There could have been no greater surprise for us than this finding of so much eastern comfort and refinement so far away from the railroad and civilization. During our entire stay we were most hospitably entertained.

The valley afforded very different scenery from what we had met with farther north. On the south high steep hills rose up from the valley, on the north were high bluffs. Back through these northern bluffs numerous narrow cañons had been cut in times long passed. In none of them was there found a spring or a drop of water. The floor was level and covered with grass. The walls often rose up by a series of great steps which were not infrequently covered with vegetation so that they presented a line of green against the light colored perpendicular walls. On top of some of the bluffs

were outcrops of a thin stratum of siliceous limestone similar to what had been found on some of the hills north of Harrison. Here, however, the siliceous matter was in the form of moss agate and made up by far the larger part of the rock.

In the upper courses of these cañons we found the "corkscrews." We certainly had not been deceived as to their size; the largest that we had seen in the neighborhood of Harrison were pigmies beside some that now presented themselves to view. Few of them were small. Stems and spirals nearly three feet in diameter were not uncommon, but they were not quite so regular and smooth as the smaller ones to which we had become accustomed during our three weeks digging. Many of them were found in which the great spiral seemed to end in a broad top, but in no instance did we see any evidence of the tree-like tops that we had been told were to be found here. The one specimen that was pointed out to us, illustrating this feature, proved to be nothing more than an irregular mass of nodules that had been exposed by the wind and rain in the bank above a "corkscrew." Between the nodules and "corkscrew" there was no connection whatever. These irregular structures of a more or less calcareous nature are very common in the formation in which the corkscrews occur, and may no doubt be found throughout the whole Niobrara formation. They seem to be mentioned by Hayden and others, and it seems strange that the same observers never saw the "corkscrew."

At Agate Springs there were no wash-outs on the south side of the river so as to enable one to say definitely whether the "corkscrew" area extends south of the river. But without doubt they may be found there. During the past year specimens have been found in Dakota, thus extending greatly the large area in which we found them in 1892.

As in the beds near Harrison, fragments were common. One, which came near being left in the field, was turned over and disclosed to view, imbedded in its mass, the legs and several vertebræ of an animal about the size of a large deer. The bones were clamped into the side of the stem just as a

shell might be by a low-growing sponge. This seemed to give additional evidence for the "sponge" idea.

The only other bones that were found on the north side of the river was an Oreodon skull. This was dug out a few inches above the upper end of a "screw." On the hills of the other side of the river, however, fragments of Rhinoceros were not uncommon.

Nearly all the specimens were so large that we were obliged to content ourselves with a few of such small ones as could be readily dug out. These we carefully packed in hay in the wagons, and after a stay at Agate Springs of only a few days, set about our return for Harrison.

After spending a day in packing up, depositing our precious corkscrews in the store room of the depot where they made a goodly pile of boxes, we left Harrison for the Bad-lands and, eventually, the Black Hills. From the Hills, at the head of Sowbelly Cañon, we caught a glimpse of the great Hat Creek Valley to the northeastward. But the view from here is not nearly as striking as that obtained from the buttes further west and north.. One can ride up to the edge of these until the broad expanse of the valley, from seven hundred to a thousand feet below, bursts upon him without warning. These views cannot fail to call forth an exclamation of wonder and admiration. At one's feet it seems as though the valley has been formed by a great fault; eastward and northeast it stretches as far as the eye can reach, on the west it rises into the hills of Wyoming, while on the north it seems bounded by the low-lying dark colored hills, the Black Hills, some seventy miles away. If the atmosphere is favorable, Harney's Peak, the highest point of the dark colored range, may be seen. Through the apparently smooth and floor-like valley meanders Hat Creek, gathering up the waters of its various tributaries as it flows along. Scattered along these tributaries, which run back into the ridge from which the view is taken, may be seen small clumps of cottonwoods, so far away as to appear like brushwood. Nearer by and along the foot of the ridge, fields of grain wave in the breeze, while here and there may be seen herds of cattle, moving specks that recall the

cowboy and the ranchman that but a few years ago held entire control of the region. Scattered about the valley, some near, some far off, appear light colored patches sparkling in the sunlight. In the midst of some of them conical mounds rise up like lonely beacons. These are the Bad-lands of Sioux County, the *Mauvaises terres* of the French Canadian traders, and the *Ma-koo-tscha* of the Dakotas.

These bare looking spots one finds upon nearer approach to be great "wash-outs" at the head of the numerous branches of the streams flowing into Hat Creek. In some cases they may be five or six square miles in extent or more, and offer some of the finest erosion scenery, perhaps, to be found anywhere. The whole extent of country covered by them is cut up into numerous and intricately branching precipitous ravines. The tops of the divides between the branches are worn down to knife-like edges, but not infrequently a large plot may be entirely cut off from the upland and present the appearance of a small table-land. It is nearly impossible for a traveller to pass through the labyrinth of ravines with a team; even to one on foot they present innumerable difficulties. They illustrate vividly the method by which nature may level the largest of continents.

From the high ridge bordering the valley on the south a descent can be made only through some of the large cañons cutting back into it. One of these is Sowbelly Cañon, which received its euphonious name from the fact that in the time of Indian troubles a body of troops became surrounded while passing through it, and were kept there so long before assistance came that they had nothing to eat but bacon, or, as it is called by the soldiers, sowbelly. Like the other large cañons it has a small stream of clear and good water, and on its sides is covered by trees and underbrush. The walls rise often perpendicularly, their whitish surfaces glistening in the bright sunlight. In some places they are broken through by branching cañons, and the isolated head-lands form buttes of striking beauty. Sometimes they simulate the works of man. One in particular, near the lower course of the cañon, looks like a gigantic castle in ruins. Here and there great breaches

appeared to have been made in the walls, while below were the great mounds of debris. At one corner appears a great ruined tower, while adding to the effect may be seen scattered patches of green where trees and grasses have caught root, and perhaps an inaccessible eyrie on the side of the cliff. When we saw it there were a pair of bald eagles soaring far above. This structure had been not inappropriately named Castle Butte. Before the advent of the white man they were really used as vantage points of defence as is abundantly attested by the large number of arrow heads that one may pick up at the bases of the cliffs.

This butte formation is characteristic of the White River country. It consists of a fine semi-petrified calcareous sandstone, often containing irregular branching and rootlike concretionary formations such as we found abundantly near Harrison and on the Niobrara. In it also are found the the "corkscrews." Below it is the bed of the Miocene lake consisting of strata of clays, marls, and sandstone, the erosion of which has formed the Bad-lands rendered famous by the paleontological discoveries of Cope, Marsh, and others.

Leaving Sowbelly Cañon behind we drove several miles down into the valley to escape the worst of the ravines near the ridge, and then turned eastward to hunt over a "patch" of Bad-lands where we were certain of finding Menodus remains. About six o'clock, after winding about nearly all day in order to pass the ravines that we could not escape in, in spite of our long detour, we finally reached the railroad near the "patch" of Bad-lands. This we followed to the watering station, Adele. Here we found a depot, a section house, and an artesian well. All through the long hot day's drive after leaving the cañon, we had found no water that did not have considerably more than the chemist's "trace" of alkali. To be sure we carried water, but this could not last long and could not be kept cool. Imagine our disgust when going to the artesian well to quench our thirst to find water so heavily charged with sulphur as to smell perhaps not quite as badly as more or less ancient eggs. We learned that the people at the section house had their water shipped to them from Craw-

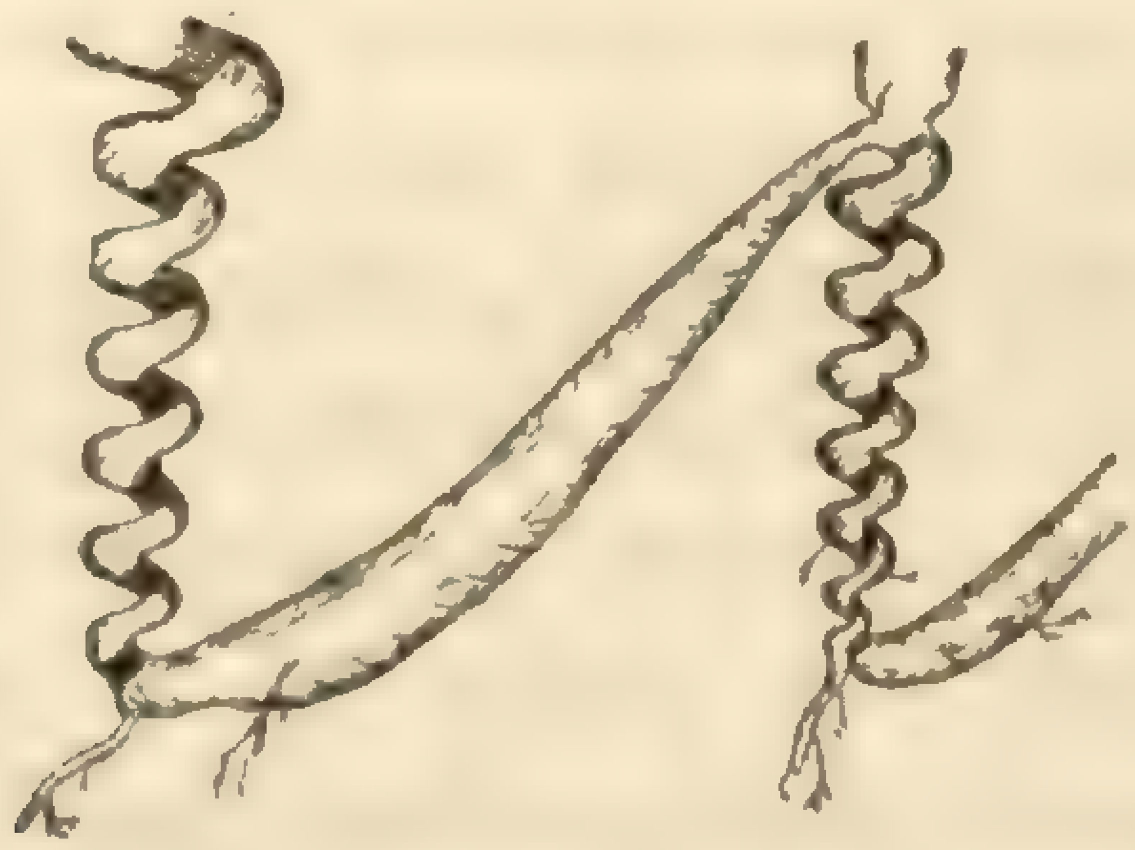
ford, about fourteen miles south of Adele. From them we "borrowed" a little water for present use, and learned of a farm house about a mile away, where we might fill our kegs. Hither we went the next day and every day during our stay in the neighborhood and found water not undrinkable, though slightly alkaline. Our horses were compelled to put up with the sulphur water, but strange to say, they did not seem to object. Perhaps they were better acquainted with the vicissitudes of the Bad-lands than we, and were philosophically willing to appreciate what they could get.

Near the depot we made our camp, sleeping on the ground, which, after pulling up a few of the cacti that were very common, did not make an unendurable bed, after a little experience. In the morning we awoke to gaze at the play of the light on the wall of the Bad-lands to the west of us. They present a beautiful appearance, which cannot be appreciated until one gets into them. Then the apparent wall becomes broken into precipitous ravines and narrow cañons with walls rising at so steep an angle as to make climbing very difficult and often impossible. The bare white surface is worn by innumerable gullies, and the inch or so of cracked, sun-baked, and friable clay rattles down the banks beneath one's feet. Not a sign of vegetation can be seen save from time to time in the cañon beds a single plant, an *Astragalus* perhaps, washed down from above and blooming here in loneliness. On some of the "tables" above, among the grasses, may be found a species of *Œnothera* and several of *Phlox*, closely hugging the ground like mountain plants. Beneath the superficial friable layer the clay forms a soft rock that has become cracked and broken into irregular lumps. Now and then a thin seam of gypsum appears, jutting above the surface, while at some of the lower levels calcedony is very common, often affording fine specimens. At one place appeared an outcrop of sandstone which had been worn into fantastically rounded forms. Almost everywhere may be seen the remains of turtles, some on their backs, some right side up, some projecting from the walls of the ravines, others on the level spots, as heaps of fragments. Few of them are small, and some may be found that will ap-

proach three feet in length. Besides the turtles, Oreodon fragments are scattered about. Among the several fine skulls of these animals that we found was one that was entirely perfect and had attached to it some four or five of the cervical vertebræ. On the levels below the three- to four-foot bed of sandstone the scattered remains of that strange looking ungulate, Menodus are frequently met with. Careful search will usually reveal an exposed piece that, when carefully followed with pick and chisels, will prove to be an invaluable specimen. During our short stay in the region a perfect lower jaw of *Menodus* was found. It was lying upside down with only one angle exposed. The rest was buried in the lumps of clay, which, from their hardness and tendency to slip upon one another, made digging very difficult. But by dint of much work with chisels, much paste, glue, many strips of cloth and paper, and much more patience, the jaw was finally freed and turned over. It was a fine specimen, all the teeth were present and perfect, and it was not noticably distorted. In none of the large museums of the east has the author seen a specimen as perfect. The pasted and glued jaw was left in the field that night which, to our anxiety, brought with it a thunder storm. We feared that we should see no more of specimen, or, that it would be totally ruined. Storms severe enough to be cloud-bursts are not unheard of in the region and when they break on the ridge they sweep with terrific force down the gullies and cañons, carrying everything before them to the valley below. Such storms explain the great amount of erosion that has been done, for in none of the cañons, save those that run far back into the ridge and have a growth of trees, can there be found a running stream of water that ever reaches Hat Creek. In some of the larger Bad-land ravines a small stream of water may be found, but such streams are usually swallowed up, leaving a perfectly dry bed before they reach the open plain or have run very far in it. Most of the ravines are completely dry. But the cloud-bursts would carry off the loose, friable, sun-baked earth on the surface of the walls, exposing the indurated clay beneath to be burnt and cracked in its turn.

The following morning we hurried to the scene of our labor and found that the storm had not been very severe. There was the jaw, but horrors, the sound teeth of the day before were all cracked and widely gaping, the glue and paste had been washed off and the whole jaw looked as though the lightest touch would knock it into a mass of useless fragments. But not a piece had fallen. Very carefully we went to work, gently pressed the yawning cracks together, and with rags, glue and melted paraffine, made the specimen as good as new.

After packing the jaw and a number of other specimens they were left at the depot to be shipped later on to Lincoln; then we bade adieu to Adele and its bad-smelling water for the more extensive Bad-lands of South Dakota.



Supposed manner of growth of Dæmonelix.

THE COLD SPRING HARBOR BIOLOGICAL LABORATORY.

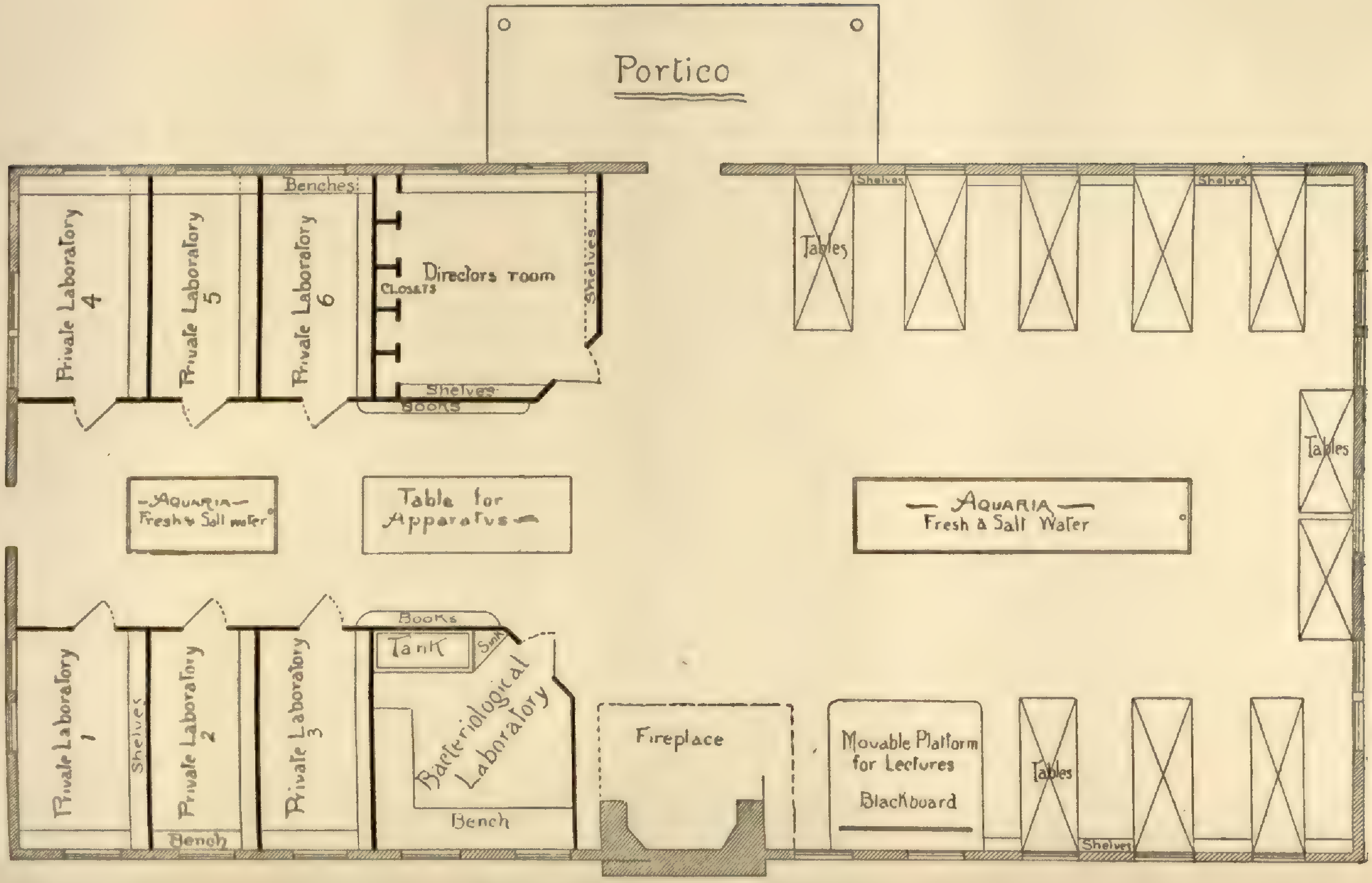
By H. W. Conn.

As elsewhere stated in these pages the American Association for the Advancement of Science at its recent meeting appropriated a sum of money to pay for an investigator's table at the Biological Laboratory at Cold Spring Harbor. This laboratory is little known to most readers of the American Naturalist and a brief account of its history and purposes are, therefore, here given.

The last fifteen years has seen established upon our coast a number of stations designed for the purpose of studying marine biology. The various stations have been quite different in their aims and in their character. Some of them have been purely private institutions where a few students are invited to the sea shore to make use of a private laboratory. In other cases certain universities have established marine laboratories designed primarily for their own students, although receiving students from elsewhere, should they choose to attend. In some cases the laboratories thus organized have been public institutions, and designed from the outset to attract all classes of students interested in biology, and to furnish to students and teachers in general a place where they may come for the purpose of pursuing summer work at the sea shore. Some of them have been planned wholly or almost wholly, for advanced work of investigation, others entirely for elementary work of instruction. Of the various laboratories above designated as public institutions only two have continued to exist for any length of time. One of these, well known to every biologist in the country, is the excellent school, stationed at Woods Holl, Massachusetts. The second one, not so well known, but rapidly coming into notice, is located at Cold Spring Harbor, Long Island.

The laboratory at Cold Spring Harbor is, in some respects, especially favorably located. At a distance of an hour's ride

PLATE XII.



Ground plan of the Laboratory.

PLATE XIII.

Laboratory building.

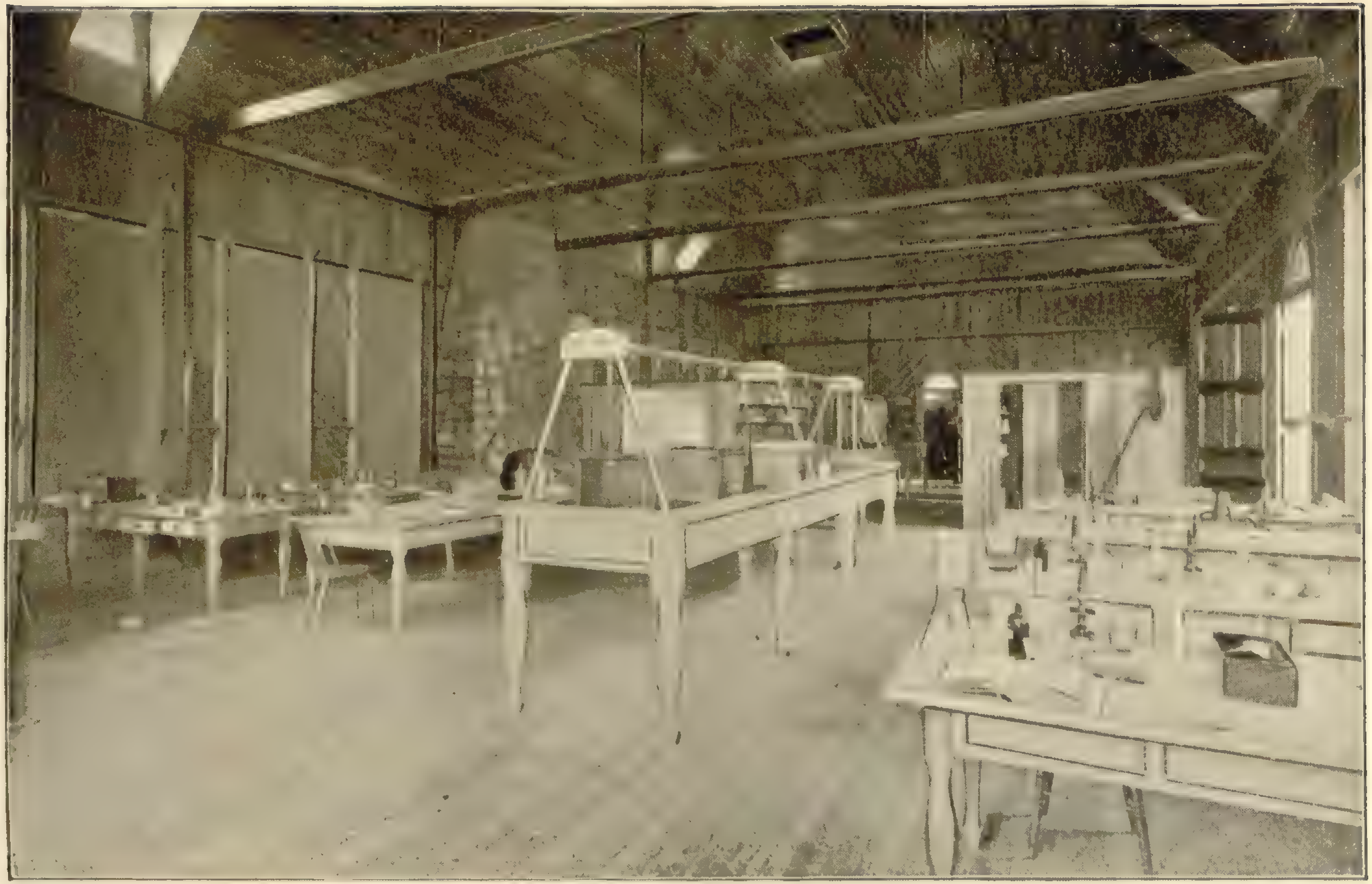
PLATE XIV.

New York Fish Commission Hatchery and out door aquaria.

PLATE XV.

Cold Spring Harbor Bay, showing the Laboratory and Floating dock.

PLATE XVI.



Interior view of Laboratory.

from New York, the great centre of travel, it is most easy of access to students in any of the eastern states. It is situated on the north shore of Long Island at the head of one of its most beautiful bays. A more charming location for a marine laboratory could hardly be chosen. At this place Long Island is somewhat hilly and wooded, in marked contrast to the general flatness which characterizes the greater part of its surface. Here the wooded hills are close to the shore and the forests extend almost to the very water's edge, giving the unusual appearance of a wooded sea shore. The beauty of the place is enhanced by the presence of numerous fresh water springs which have given rise to the name of Cold Spring Harbor, and which pour an undiminished current of the clearest, coldest fresh water into the bay at all seasons of the year, unaffected in amount or in temperature, winter and summer alike. Three beautiful ponds produced by these springs give a fresh water fauna and flora which, added to the marine life of the bay, make the location of the Cold Spring Harbor in some respects unique and especially favorable for biological work.

The biological laboratory at Cold Spring Harbor was organized as a branch of Brooklyn Institute of Arts and Sciences. The excellent work of this institution of public instruction is widely known in educational circles. In the year 1889 Professor F. W. Hooper, its secretary, conceived the desirability of establishing as a branch department of the work of the Institute, a summer school of biology. With the coöperation of the New York State Fish Commission and a number of gentlemen who became interested in the undertaking, the Brooklyn Institute organized such a summer school of Biology, which was located in the building of the New York Fish Hatchery at Cold Spring Harbor and held its first session in July and August, 1890. The school has continued at the same place until the present time, holding a session each summer, and has been constantly growing in size and in the value of the work that it carries on. The laboratory still retains its connection with, and has been partly supported by the Brooklyn Institute, although it is drawing its students from a larger and larger

range of territory. At the present time it receives its patronage from a large number of educational institutions and from many of our eastern states. The school has been supported by the Brooklyn Institute aided by the generosity of many friends who have recognized the value of the work. During the first summer the direction of the school was in the hands of Dr. Bashford Bean, now of Columbia College, but during subsequent years of its history and at the present time it is under the direction of Professor H. W. Conn of Wesleyan University. Associated in the work of carrying on instruction have been a number of professors and instructors from our colleges and schools, and each year a competent board of teachers is present to assist the director in carrying on the work of the school.

When the school was organized, it, of course, had no laboratory or equipment. Except for the generosity of the New York Fish Commissioners the school would scarcely have been possible. This board kindly offered to the Institute the use of their hatchery at Cold Spring Harbor, which is very little used during the summer. For three years this building was occupied by the school. Necessary collecting and laboratory apparatus were purchased and with these inadequate conveniences three successful sessions were held. It became evident during the third year that if the school were to succeed it would need a building of its own. The laboratory had by this time made warm friends at Cold Spring Harbor and they generously offered to erect a laboratory building for the purposes of the school. The building was erected in 1893 at an expense of $10,000 and was occupied in completeness for the first time in 1894. The new laboratory is capable of accommodating 50 students, and being especially designed for the school, is admirably adapted to its needs. It contains a general laboratory for general students; private laboratories for investigators; a library; bacteriological laboratory; aquaria furnished with running water, both salt and fresh. In addition, the institution owns boats and collecting apparatus; has a lecture hall and a dark room for photographing, in a separate building; and has the use of a large building devoted to boarding the members of the

laboratory party. During the coming Spring a dormitory building for lodging the students is to be erected, which will add greatly to the conveniences of the students. The equipment of the laboratory in the way of microscopes, small apparatus, chemicals, etc., is excellent, and embraces everything needed to make profitable a summer at the sea shore.

While the object of marine laboratories on our coast has been varied, at the outset most of them were started almost solely for the purpose of encouraging research. In several cases they consisted at first in the collection of a small number of advanced students from special universities who came to the sea shore for the purpose of carrying on work that they could not carry on at home. These little nuclei, in some cases, have grown into large schools and in other cases have remained small collections of investigators. These early students have everywhere taken their places in our institutions of learning and, appreciating their own debt to sea shore work, they are ever encouraging others in the same line of study. As the small laboratory has grown into the school its object has somewhat changed, but in most of the marine schools, that are at present in existence on our coasts, the primal object is that of original research and investigation. In recent years more attention has been given to courses of instruction, but all of the schools, except that at Cold Spring Harbor, aim primarily at encouraging investigation.

The biological laboratory at Cold Spring Harbor was organized, however, with a somewhat different purpose. The Brooklyn Institute itself is a school of public instruction, and the biological school which it organized naturally assumed from the very outset more of the character of a school of instruction than one of research. From the first the aim of the Cold Spring Harbor school has been to furnish a place where instruction in biology of the highest character could be given. For this purpose regular courses of lectures accompanied by courses of laboratory work have been given each year, and, while inviting and encouraging research, its first aim has been instruction. The ordinary student needs guidance the first one or two years at the sea shore. To give him laboratory

facilities without systematic instruction results in much misdirected work. Without systematic courses of instruction many of those desiring the advantages of marine work will spend the summer in desultory work to little profit. To avoid this result the management of the school have planned regular courses of lectures accompanied by laboratory work of the same character as the biological courses in our colleges. The courses which are given at the present time are the following: 1. Elementary Zoology; a course of lectures with laboratory work upon zoological types. 2. Comparative Embryology; this consists of thirty lectures upon embryology, accompanied by practical work with illustrative embryological types. 3. Elementary Botany; including instruction in the study of flowering plants. 4. Cryptogamic Botany; a course of lectures with laboratory work upon the chief types of cryptogams. 5. A course in bacteriology; including 15 lectures upon the history of bacteriology and practical work upon bacteriological methods. All regular courses last six weeks, although the laboratory is open for a longer period. The work done in these courses is of the highest character. Those engaged in instruction are from our best colleges, and the nature of the courses which they give is almost identical with the courses given in the colleges themselves. Indeed, in some respects, the work in these courses at the summer schools is considerably in advance of the work that is done in the colleges in the same departments. The student at the laboratory has several weeks of uninterrupted work upon one subject, and his thoughts are not distracted by numerous other branches of learning which he is pursuing at the same time. This makes it possible for the instruction to be even more thorough and of a higher character than is possible in our colleges. The work in biology done in the school at Cold Spring Harbor is, therefore, of exactly the same character and in some respects more thorough than the biological work in the colleges. Of course not so many branches are taught as may be found in our colleges, but the branches that are taught, which are those especially requiring living specimens at the sea shore for study, are pursued with thoroughness.

The laboratory proposes further to increase its usefulness by furnishing material for class work to our schools. Marine specimens for school purposes have been difficult and expensive to obtain. The Cold Spring Laboratory, therefore, will furnish common types of marine animals at low prices to such schools as need them for work with classes.

For these reasons the school at Cold Spring Harbor offers itself as an especially favorable place for certain classes of students. Students in our colleges who wish to complete the biological work of the inland schools by practical study with animals at the sea shore will find the systematic courses here given of great use to them. Public school teachers who need a practical knowledge of animals and plants to enable them to teach the subjects of zoology and botany in an interesting manner to their students; advanced college students who have taken elementary work and desire a practical knowledge of comparative embryology or advanced zoology; medical students whose regular work in the medical school is so crowded as to leave them little time for general reading; all of these will find the training to be obtained at the summer schools, in general biology, of the utmost value. College professors, too, who desire to make collections for their classes and to obtain material for their own original work will find a place here. All of these classes of students are among the attendants of the school at Cold Spring Harbor and all find much of interest and value in the work at the school.

While, at the beginning, the object of the school at Cold Spring Harbor was to furnish a place of instruction, the more advanced side of biological work has been by no means neglected. The laboratory now in use contains private rooms for investigators. The instructors in the school and the college professors who have been present with the school in past years have been carrying on investigations of original character. Every facility is afforded to those advanced workers who desire to carry on research, and it is the aim of the management of the school to increase rather than to diminish the facilities for investigation, and thus to attract a large number of students engaged in research. During the last summer the

school at Cold Spring Harbor received its first public scientific recognition by the American Association for the Advancement of Science. This Association, on one of the excursions taken by it during its session at Brooklyn the past summer, went to Cold Spring Harbor, and a large party interested in biological work visited the laboratory. The appreciation of the Association for the character of the work done was shown by an appropriation to the school for aiding in original investigations. This money is to be used to pay for the rental of two private rooms to be known as American Association tables, and, as announced elsewhere in this magazine, these tables are open for application to all students of American biology.

The school of Cold Spring Harbor has a field for itself. The growing importance of biological work in our schools is creating yearly an increasing demand for facilities for summer work. The modern teacher is fast learning that he cannot hold his own in zoological or botanical lines without opportunities of practical work with living animals and plants; and these opportunities can be had only at the sea shore itself. There is, therefore, a growing number of teachers who are desirous of spending their summers in adding to their equipment for such work. A growing number of students are recognizing, that, in order to take their stand in the front ranks in our educational communities, a summer or two or more at a marine laboratory is becoming as inevitable a necessity as a college education itself. This growing demand is not to be met by one or two schools, but will necessitate in the future the establishment of many institutions of public instruction. The school at Cold Spring Harbor, by placing emphasis upon this matter of public instruction to teachers and students, has obtained a place for itself. Its continued success and its constant growth during its history prophecies well for its future and promises that it will remain as one of the permanent institutions of public education in America.

MINOR TIME DIVISIONS OF THE ICE AGE.

BY WARREN UPHAM.

The following study, forming the conclusion of Part VI in the Twenty-third (1894) Annual Report of the Minnesota Geological Survey, may be regarded as a continuation or supplement of my paper, on the periods of the Quaternary era, given in the AMERICAN NATURALIST last December. It seems to supply a compromise between the doctrine of unity of the Glacial period as held by Dana, Wright, and others, and the alternative doctrine of its duality or greater complexity as held, among American glacialists, by Chamberlin, Salisbury, McGee, and others. Unity or continuity of our Plistocene glaciation, with moderate fluctuations of the ice margin, appears to the present writer the more acceptable view and expression, when the whole period and the whole drift-bearing area are considered. This time was long as measured by centuries or thousands of years, but was in a geologic sense brief as compared with all other geologic periods or epochs, excepting only the shorter, unfinished Recent or Present period.

Seeking to subdivide the Ice age with reference to its dynamic causes and secular fluctuations in climatic conditions, we find, first, a long epoch of general snow and ice accumulation. In its early part the growth of the ice-sheet was interrupted, at least locally and temporarily, by moderate oscillations of its boundary, as shown by layers of lignite between deposits of till observed by Dr. Robert Bell on branches of the Moose and Albany rivers tributary to the southwest side of James bay.[1] Later, after the ice-sheet attained its maximum stage in the Mississippi basin, reaching south to northeastern Kansas, central Missouri and southern Illinois, this epoch included a long interval of extensive retreat of that part of the ice-sheet, followed by renewal of its growth until it again reached far

[1] Geol. Survey of Canada, Report of Progress for 1877–78, p. 4 C; and Annual Report, new series, vol. ii, 1886, p. 38 G.

south toward its former limits. This part of the Ice age is well denominated, from its envelopment of the land by ice-sheets, the Glacial epoch. Its chief cause I think to have been uplifts of the glaciated regions thousands of feet above their present height.

Forest beds and other fossiliferous deposits of the interglacial stage in this epoch are found frequently, and on some large tracts almost continuously, occurring between deposits of the till or glacial drift penetrated by wells, from southeastern Ohio, through Indiana and Illinois, to northeastern Iowa and to Mower county in southern Minnesota.[2] Less frequent, but still sometimes occupying considerable tracts as shown by several wells near together, these interglacial beds are recorded by my notes of wells in Lyon, Renville, and McLeod counties, Minn., 60 to 90 miles north from the south line of this state. More rare instances of their observation are noted as far north as in Mitchell township, Wilkin county, and Barnesville in the south edge of Clay county, Minn.; and these most northern localities are situated within the area of the glacial lake Agassiz, respectively about 100 feet and 75 feet below its highest and earliest or Herman beach. If the altitude and slopes of the land had been then the same as now, an interglacial lake, held by the barrier of the receding ice-sheet, must have forbidden the growth of forests or formation of swamp deposits there, until the outlet was deeply eroded or much farther glacial recession permitted that lake to be drained away northward. Under those conditions an interglacial forest at Barnesville would imply probably three to six times more glacial melting and recession than otherwise would suffice to account

[2] Charles Whittlesey, Smithsonian Contributions, No. 197, in vol. xv, 1864, pp. 13-15.

J. S. Newberry, Geology of Ohio, vol. ii, 1874, pp. 30–33.

G. F. Wright, The Ice Age in North America, 1889, pp. 475–496.

Frank Leverett, Proc. Boston Soc. Nat. Hist., vol. xxiv, pp. 455–459, Jan. 1, 1890; Journal of Geology, vol. i, pp. 129–146, with map, Feb.–March, 1893.

W J McGee, Eleventh An. Rep., U. S. Geol. Survey, for 1889–'90, Part I, pp. 486–496.

N. H. Winchell, Proc. A. A. A. S., vol. xxiv, for 1875, Part II. pp. 43–56; Geology of Minnesota, Final Report, vol. i, 1884, pp. 313, 363, 390.

for the most northern of these observed interglacial deposits. It therefore seems to me more likely that during this glacial retreat the present basin of the Red river of the North, which was later occupied by lake Agassiz, had a considerably greater altitude than now, retaining a part, probably a large part, of its preglacial elevation, and that it was thus a land surface with southward descent and free drainage along the Minnesota river valley to the Mississippi. The recession of the ice-sheet, before its renewed growth, may then have reached only to the southern part of the Red river valley, instead of the great farther distance to Hudson bay, which I formerly supposed in writing of these interglacial beds in Minnesota.[3]

The erosion of numerous and large interglacial stream courses in the early drift sheet of southern Minnesota and northern Iowa, including the Minnesota river valley and its continuation past Brown's Valley and above the bed of lake Traverse, channeled then apparently about 50 feet (or more) below the general surface of the adjoining country to the level of the Herman beach of lake Agassiz,[4] finds full explanation in this retreat of the ice-sheet to the vicinity of Mitchell and Barnesville, 200 to 250 miles inward from its farthest limits in North Dakota and on the northern boundaries of the Wisconsin driftless area, but 500 miles north from its limits in Kansas and Missouri.

During the ensuing stage of its renewed accumulation and growth, the ice-sheet reached from Barnesville about 200 miles westward into North Dakota, an equal distance eastward into northwestern Wisconsin and southeastern Minnesota, and some 350 miles or more south-southeastward in Iowa. Not only were the interglacial forest beds thus covered, but a marginal moraine, which had been formed probably during a slight pause or readvance interrupting the later part of the intermediate glacial retreat, was likewise buried and is now indicated by exceptionally abundant boulders in a stratum of the drift

[3] Geology of Minn., Final Report, vol. i, 1884, pp. 402, 406, 466, 479–485, 507, 511, 552, 580, 581, 585–6, 609, 625; vol. ii, 1888, pp. 138, 186, 187, 199, 456, 529, 555, 662, 668.

[4] Proc. A. A. A. S., vol. xxxii, for 1883, pp. 222–227. Geology of Minn., vol. i, pp. 479–485, 507, 580; vol. ii, 134, 172, 216, 519–525.

shown in the bluffs of the upper part of the Minnesota river valley and by its tributaries, overspread by 25 to 50 feet of the later deposits of till.[5]

The two stages of growth of the ice-sheet may have been due, aside from their principal dependence on the high elevation of the land, to the climatic effects of the last two passages in the precession of the equinoxes, with accompanying nutation, bringing the winters of the northern hemisphere in aphelion about 30,000 years ago and again about 10,000 years ago. The intermediate time of the earth's northern winters in perihelion would be the stage of great retreat of the ice margin in the upper Mississippi region; but eastward, from Ohio to the Atlantic coast, there appears to have been little glacial oscillation.[6] This explanation accords with Prof. N. H. Winchell's computations from the rate of recession of the falls of St. Anthony for the Postglacial or Recent period,[7] and with his estimate of the duration of the interglacial stage from the now buried channel which appears to have been then eroded by the Mississippi river a few miles west of the present gorge below these falls.[8]

The chief cause of the Ice age is here thought to have been a high epeirogenic uplift; but the very noteworthy subdivision of the Glacial epoch in the upper Mississippi basin is ascribed to climatic conditions resulting from the same astronomic cycle of 21,000 years which Croll supposed to have been efficient, during the remote time of maximum eccentricity of the earth's orbit, to produce alternating glacial and interglacial epochs. Wallace, in his discussion of this subject in "Island Life," thinks that great altitude of the glaciated countries coincided with the last stage of maximum eccentricity, from 240,000 to 80,000 years ago, to cause the Ice age,

[5] Geology of Minn., vol. i, p. 626.

[6] J. D. Dana, Am. Jour. Sci., III, vol. xlvi, pp. 327–330, Nov., 1893.

[7] Geol. and Nat. Hist. Survey of Minnesota, Fifth An. Rep., for 1876, pp. 175–189; Final Report, vol. ii, 1888, pp. 313–341, with fifteen plates (views showing recent changes of the falls of St. Anthony, and maps). Quart. Jour. Geol. Soc., London, vol. xxxiv, 1878, pp. 886--901.

[8] Am. Geologist, vol. x, pp. 69–80, with three plates (sections and a map), August, 1892.

altitude and eccentricity being thought perhaps of nearly equal influence. The view here presented looks on the Glacial period as occurring in a much later time of low eccentricity, and for its causation regards altitude as far more efficient than any astronomic conditions. The effects of varying astronomic conditions have been recently considered by Dr George F. Becker,[9] who thinks, altogether differently from Croll, Geikie, and Ball, that the combination of minimum eccentricity of the earth's orbit and maximum obliquity of the ecliptic is most favorable for snow and ice accumulation; and he states that these conditions have existed within the past 40,000 years, until 8,000 years ago, but he apparently would attribute a larger share of the causes of glaciation to geographic conditions, as land elevation. In Europe a very remarkable parallelism of the history of the Ice age with that in America[10] indicates dependence on similar causes, chiefly geographic, as epeirogenic movements, with changes of ocean currents, and subordinately astronomic.

If the Glacial period extended through 30,000 or 50,000 years, depending principally on epeirogenic uplifts and in less degree on the cycles of precession of the equinoxes, it would agree well with Geikie's and Chamberlin's complex history of wavering glaciation, and also with its essential geologic unity and brevity which have been insisted on by Dana, Wright, Hitchcock, Lamplugh, Kendall, Falsan, Holst, Nickitin, and other glacialists. To my mind the diversity and the unity of this period seem like the opposite gold and silver sides of the proverbial shield, concerning which two knights, each having seen only one side, valiantly contended.

Widely extended depression of the ice-burdened land, until mostly it had somewhat less altitude than now, initiated the comparatively short final epoch of the Glacial period. Temperate and warm climatic conditions on the ice border, nearly as now on the same latitudes, then melted away the ice

[9]Am. Jour. Sci., III, vol. xlviii, pp. 95–113, Aug., 1893.

[10]James Geikie, The Great Ice Age, three editions, 1873, 1877, and 1894, notably pp. 774, 775, in the third edition; Journal of Geology, vol. ii, p. 739, Oct.–Nov., 1894; Am. Geologist, vol. xv, p. 54, Jan., 1895.

rapidly; its chief stage of loess deposition attended the early part of this glacial retreat; the partially unburdened land began to rise by a moderate uplift, approximately proportional to the glacial melting and nearly keeping pace with it;[11] and conspicuous belts of morainic drift were amassed whenever the steep waning ice-front slackened its departure, or halted, or for any short time reädvanced. The general but fluctuating retreat of the ice-sheet at length uncovered all the country and constituted the closing or Champlain epoch of the Ice age, so named from the marine beds of that time overlying the till in the basin of lake Champlain and along the St. Lawrence and Ottawa valleys, by which the vertical extent of the subsidence terminating the Glacial period and of the succeeding reëlevation is measured.

Adopting the helpful new nomenclature proposed by Chamberlin,[12] we may provisionally formulate the minor time divisions of the Glacial and Champlain epochs as follows. The order of this table, as of the former more comprehensive one on page 988 of the last December AMERICAN NATURALIST, is stratigraphic, so that for the advancing sequence in time it should be read upward.

NOTE.—If we seek to compare this table with the Glacial series in Europe, it should be remarked that in the Alps there were three chief stages of growth of the glaciers far beyond their present limits, the second being the maximum advance, doubtless contemporaneous, as shown by Geikie, with the maximum extension of the ice-sheet upon northern Europe. The first glacial stage of the Alps, which also appears to have left traces in southern Sweden not wholly obliterated by the next and greater glaciation, may be represented in America by the till beneath the interglacial lignite in the basin of James bay, and these may belong to the time of northern winters in aphelion some 50,000 years ago. The second, third, and fourth glacial stages of the European Ice age, as tabulated by Geikie, are then seen to be wholly analogous in characteristics of ice extension and drift deposition, and they were probably also time equivalents, respectively, with the Kansan, Iowa, and Wisconsin stages in the United States and Canada. In each continent the interglacial time between the Kansan and Iowan stages had

[11] Journal of Geology, vol. ii, pp. 383--395, May–June, 1894.

[12] In two chapters (pages 724–775, with maps forming plates xiv and xv) of J. Geikie's "The Great Ice Age," third edition, 1894, Prof. T. C. Chamberlin proposes a chronologic classification of the North American drift under three formations, named in the order of their age, beginning with the earliest, the Kansan, East Iowan, and East Wisconsin formations.

great subaërial erosion because of the continuing high elevation of the land; and the latest or moraine-forming stage of the glaciation seems, alike in Europe and America, to have belonged to the mainly rapid but fluctuating final retreat of the ice, showing, as I think, that each ice-sheet had in its lower part much englacial drift.

Epochs and Stages of the Glacial period.

CHAMPLAIN EPOCH (Land depression; disappearance of the ice-sheet; partial reëlevation of the land.)	WISCONSIN STAGE . . . (Progressing reëlevation.)	Moderate reëlevation of the land, advancing as a permanent wave from south to northeast; continued retreat of the ice along most of its extent, but its maximum advance in southern New England, with fluctuations and the formation of prominent moraines; great glacial lakes on the northern borders of the United States; slight glacial oscillations, with temperate climate nearly as now, at Toronto and Scarboro', Ont.; the sea finally admitted to the St. Lawrence, Champlain, and Ottawa valleys; uplift to the present height completed soon after the departure of the ice. (The great Baltic glacier, and European marginal moraines.)
	CHAMPLAIN SUBSIDENCE	Depression of the ice-covered area from its high Glacial elevation; retreat of the ice from its former Iowan limits; abundant deposition of loess.
GLACIAL EPOCH (Ice accumulation, due to the culmination of the Lafayette epeirogenic uplift.)	IOWAN STAGE	Renewed ice accumulation, covering the forest beds and extending south nearly to its early boundary. (Third European glacial stage.)
	INTERGLACIAL STAGE .	Extensive glacial recession in the upper part of the Mississippi basin; cool temperate climate and coniferous forests up to the waning ice border; much erosion of the early drift.
	KANSAN STAGE	Maximum extent of the ice-sheet in the interior of North America, and also eastward in northern New Jersey. (Maximum glaciation in Europe.)
	UNDETERMINED STAGES of fluctuation in the general growth of the ice-sheet.	Including an early glacial recession and reädvance in the region of the Moose and Albany rivers. (First glacial stage in the Alps.)

THE SKUNK AS A SOURCE OF RABIES.

By W. Wade.

Doubtless many of the readers of the Naturalist have heard the story that the bite of a skunk can convey rabies. I first heard it some years since in the form of an inquiry from a distinguished physician in London; and to an old fox-hunter, who has known of hounds by the dozens being skunk-bitten with no subsequent ill-effects, the story was exceedingly ridiculous. But when my friend stated that Dr. John H. Janeway, a surgeon in the U. S. Army, was said to have given the story his endorsement in a New York medical journal, the matter became immediately worthy of most serious consideration, my friend suggesting that there might have been something in the environments of the skunk, at the time Dr. Janeway wrote, to account for the marvelous exception, and I at once set to work to investigate what was known on the matter. Immediately I was involved in a maze of contradictions, no two stories agreeing. No belief of the story could be found anywhere but in Texas, the Indian Territory, and adjacent districts. Even in southern Kansas no such belief was found. Then in some cases it was the skunk, *Sui generis*, that had this power, while again it was only one particular variety of the skunk, the "hydrophobia cat." The vulgar idea was that any skunk, rabid or non-rabid, was capable of conveying infection of rabies, while more intelligent observers held that only a rabid skunk had this power, but even these seemed to hold that there was special danger of skunks being rabid, or that the virus conveyed by their bite was more potent than that from any other rabid animal. Again, instances were cited of men dying as the result of a skunk bite; in one case after many months of lingering illness, which most certainly could not he rabies, or another case of a man exhibiting rabic symptoms after a skunk bite but recovering on copious bleeding, and evidently there was no rabies *there*. Again, the New

York Sun, about six months since, had a most blood-curdling story of many soldiers in Mississippi dying from the bite of a skunk, and the deaths spread over a period of several months, a marvelously long-lived skunk to live a month after rabies had developed to the stage of being communicable, and inquiries in Mississippi showed that no fatal case of skunk bite was ever known there, although skunks were sometimes kept as vermin killers.

Now remember that this story drew all the weight it could have from the allegation that *Dr. Janeway had endorsed it*, and remember further, that the belief was that the skunk, *at present*, had this power. At last I was able to get Dr. Janeway's paper, which was published in The Medical Record of New York, March 13, 1875, and a more ridiculous breaking down of a ridiculous myth I never saw.

It appears that Dr. Janeway was stationed at Fort Hays, Kansas, when an epidemic of rabies broke out in the surrounding country, and his paper in the Medical Record was based on his report to the Surgeon-General of the U. S. Army; and in a letter to me he says that after writing this paper to the Medical Record, he endeavored to trace the origin of the epidemic, and if he remembers aright, found by inquiries that it was first noticed in the northern tier of Texas counties, and travelled north by west to the Fort Hays reservation.

So far from Dr. Janeway stating that *any* skunk could convey rabies, he distinctly refuted the assertions of some clergyman to this effect, citing instances of dogs and men being bitten by a skunk without injury (and one case wherein one person died and two escaped unhurt from the bite of the same rabid wolf). Dr. Janeway gives a very qualified adhesion to the belief that the bite of a rabid skunk was fatal in a larger proportion of instances than the bite of other animals, and thus explains it:

"That more cases, proportionally, may result fatally from the bite of this animal than from the bite of rabid dogs and wolves, is probably, if not actually, the case; still there are obvious reasons for it to be so. An animal, nocturnal in its habits, generally timid, but armed with a powerful battery to

resist any injury or affront; one that will not bite in defence until the secretion provided for it by nature is exhausted, loses that secretion by the disease. It is a well authenticated fact that rabid skunks are entirely free from the odor so characteristic of these animals, which could not occur if the secretion were not exhausted; and forgetting its normal timidity, will attack any person or animal it may come in contact with, biting the most exposed parts of the body, the alæ of the nose, the lobe of the ear, the thumb or one of the fingers, and passes on. Here is probably the reason these bites are more fatal than those of other animals—always in a vascular part not protected by clothing—which prevents by wiping away the poisonous saliva, from the fierce attacks of the mad dog or wolf and thus saves the life of the one bitten." This is very intelligible and reasonable.

Then, even those who believe that only the *rabid* skunk conveys rabies by its bite, and that the skunk is more susceptible to rabies than other animals, seem to believe that this is the *present* state of affairs, that skunk bites are *now* peculiarly dangerous. Now Dr. Janeway expressly says that rabies was epidemic in Texas when he made his observations on the disease in skunks and other animals, thus: "Rabies Mephitica, like Rabies Canina, is evidently epidemical, no cases of it having been reported previous to 1870 in this region;" and in his letter to me of December 15th, he says: "The epidemic was short-lived, no cases that I heard of occurring the next year. A great number of skunks must have succumbed to the disease, as they were less plentiful after that season;" and further, a surgeon in the U. S. Army, now stationed at Fort Bliss, writes me: "I have served five years in Texas, four in the Indian Territory, four in Dakota and other places where skunks abound; during this time, I have never known anyone to be bitten by the animal referred to. The bite of a rabid skunk will, of course, produce the disease, and in other instances where serious trouble has followed this occurrence, I am of the opinion that the symptoms are due to septic poisoning. The bite or scratch of almost any animal is more or less poisonous from the bacteria always present on the teeth

and claws. Even *human saliva* is poisonous when injected into certain animals, as has been conclusively proved by our present Surgeon-General."

Now I have never been able to get hold of anybody, in Texas or elsewhere (of course, other than Dr. Janeway), that had ever seen a case of skunk rabies, or who had anything like definite evidence on the matter; "I have heard it," "It is generally believed," etc., has been the utmost limit of statements on this point. Some believe it themselves, but are completely "out of reasons for it." One well-known naturalist puts his views on the question in this form :

"1st. The bite of the skunk often communicates rabies and death.

"2nd. Skunk rabies kills more people than dog or wolf rabies.

"3rd. To be bitten by a skunk is to risk a terrible death.

"4th. Beware of all skunks, for one can never tell when a rabid skunk will come along."

And perhaps this expresses intelligent, but incorrect, belief on the subject as well and accurately as it can be done. Therefore let us examine what the actual evidence on the matter is. Dr. Janeway, like any intelligent physician would do, refutes the self-originating idea of rabies in the skunk (and parenthetically, a physician with all the light of recent knowledge as to rabies, tells me that Dr. Janeway's conclusions are singularly sound and conclusive, when the deficency of exact knowledge on the disease, then the case, is taken into consideration). That idea is such utter nonsense that only the erroneous assertion of Dr. Janeway's endorsement entitled it to a second thought. Then Dr. Janeway positively says in his paper in The Medical Record that rabies was epidemic when he made his observations, and he adds in his letter to me that this epidemic was so transient that in one year it had passed away. (Scientific men have suggested, as the probable explanation of such epidemics wearing themselves out, that the subjects die off faster than they can communicate the disease to fresh victims). A surgeon in what is now the central seat of belief in the "skunk-rabies" delusion has not heard of a

case in the nine years he has been in this district. A physician in Southern Kansas, not remote from Fort Hays, wrote me that he had never heard of the skunk-rabies belief, that skunks were not uncommon as pets in his neighborhood (deprived of their scent powers, I believe). From Southern Colorado to North Dakota, I can find no belief prevailing in this myth. Then it all amounts to this: Dr. Janeway made careful observations twenty years ago, during an epidemic, he says this epidemic lasted only a year. A surgeon in the U. S. Army tells us that the ill effects that *do* sometimes follow skunk bites may readily be accounted for as septic poisoning, just as might result from the bite of a fly or the scratch of a tiger's claws. Therefore, my answers to the points I quote from a well known naturalist are:

1st. The bite of a non-rabid skunk can communicate no *rabies*, and it is beyond question that rabid skunks are exceedingly rare, if found at all. In no part of this country were rabid skunks ever reported save during a short period of epidemic rabies in Texas and Kansas.

2nd. Skunk rabies perhaps killed more people in Texas, etc., during a certain period than canine rabies, but because sleeping in the open air ("camping") was common there and the skunks readily encountered men. I think that statistics would show that dog and wolf rabies has caused twenty times the deaths that skunk rabies has.

3rd. To be bitten by a skunk is to risk contracting septic poisoning, I believe a terrible death, and the bite of a fly is said to have produced the same disease, and I think a butcher cutting himself with his butchering knife is in the same danger, but none of them risk *rabies*.

4th. Well, yes, "beware of all skunks" on "smelling" grounds, but it might as well be said "beware of all dogs, for one can never tell when a rabid dog may come along."

Minimizing dangers that are real is most dangerous and reprehensible, but making spooks of mist is but little less so. Some boy reads or hears that skunk-bite "will make a man go mad," some day he does get a skunk bite, and we can easily imagine the terrors he suffers from, and all from the veriest bosh.

The subject of rabies is now loaded down with quite enough rubbish, such as the absurd notion that if a healthy dog bites a man and subsequently becomes rabid, the man will "go mad" also, and adding another piece of bosh is more than we ought to be afflicted with.

I fear I may just now be venturing beyond my depth, and therefore, I wish the following to be taken entirely as suggestive: Must it not have been under very exceptional circumstances that rabies was first introduced among skunks in Texas? It surely is true that rabies is especially a disease of the canidæ, dogs, wolves and ? foxes. Now a rabid dog (and I suppose, a rabid wolf), in the stage of the disease in which communication of infection is possible, is about destitute of intelligence. It runs blindly, wildly, and without purpose. The skunk is both nocturnal and retiring, and would easily and naturally get out of the way of a rabid dog "on the run." In Europe where rabies is more prevalent than in this country, the polecat and other animals, relatives and of similar habits to the skunk, are never known to be rabid. So how in the world did the first rabid skunk become so? Unquestionably there *were* rabid skunks, and almost certainly there was a first one who communicated the disease to its fellows, and does it not seem certain that this first victim became infected under most peculiar and exceptional circumstances, and that these are not likely to be be repeated? And, as a final wind-up, What is all this pother about? There is not a particle of evidence that skunk bites are particularly dangerous, and while nobody need wish for such a bite, if he *does* get it he need not worry himself about any danger of rabies.

THE CLASSIFICATION OF THE LEPIDOPTERA.

By Vernon L. Kellogg.

The new provisional classification of the Lepidoptera by Professor J. H. Comstock,[1] based on characters drawn from the wing-structure, presents as its most radical departure from earlier arrangements, the erection within the order of two suborders. One of these groups, the Jugatæ, is thus defined by Professor Comstock: "This suborder includes those moths in which the two wings of each side are united by a membranous lobe, the jugum, borne at the base of the inner margin of the fore wings, and in which the anal area of the hind wings is reduced while the radial is not. The most available recognition character is the similarity in venation of the two pairs of wings; radius being five-branched in the hind wings as well as in the fore wings." This suborder comprises but two families, the Hepialidæ and the Micropterygidæ, each family containing but one genus, *Hepialus* and *Micropteryx* respectively.

The suborder Frenatæ is characterized as follows: "This suborder includes those moths and butterflies in which the two wings of each side are united by a frenulum, borne at the base of the costal margin of the hind wings, or by a substitute for a frenulum, a large humeral area of the hind wings; and in which radius of the hind wings is reduced to an unbranched condition, while in the more generalized forms the anal area is not reduced. The most available recognition character is the dissimilarity in venation of the two pairs of wings, due to the unbranched condition of radius of the hind wings, while this vein in the fore wings separates into several branches." The Frenatæ includes all the families of Lepidoptera except the Hepialidæ and the Micropterygidæ.

[1] Comstock, John Henry. Evolution and Taxonomy: An Essay on the application of the Theory of Natural Selection in the Classification of Animals and Plants, illustrated by a study of the evolution of the wings of insects and by a contribution to the Classification of the Lepidoptera, pp. 37–113, with 33 figs. and 3 plates, in the Wilder Quarter-Century Book, 1893, Ithaca, N. Y.

Properly to estimate the value of these subordinal characters it may be necessary for systematists to acquaint themselves with the position of Professor Comstock regarding systematic work. His point of view may differ from that of some. The essential feature of it is the insistence upon the constant recognition of the theory of descent in systematic work, no matter how circumscribed the group which is being studied. "The description of a species, genus, family or order will be considered incomplete," says Professor Comstock, "until its phylogeny has been determined so far as is possible with the data at hand."

The purpose of this paper, which is merely to add a few notes of observations which seem to be confirmatory of the most conspicuous feature of this new classification of the Lepidoptera, makes it impracticable to refer at all adequately to the method proposed by Professor Comstock for phylogenetic studies, but it is necessary to call attention here to the following paragraph from the essay referred to.

"In attempting to work out the phylogeny of a group of organisms, there will arise, I believe, the necessity of distinguishing between two kinds of characters: first, characters indicating differences in kind of specialization; and second, characters indicating differences in degree of specialization of the same kind. The former will indicate dichotomous divisions of lines of descent; the latter will merely indicate degrees of divergence from a primitive type. Thus, to draw an illustration from the following pages, it is shown that there are two distinct ways of uniting the two wings of each side in the Lepidoptera; they may be united by a frenulum, or they may be united by a jugum. These are differences in kind of specialization, and indicate two distinct lines of descent or a dichotomous division of the order. Among those Lepidoptera in which the wings are united by a frenulum, great differences occur in the degree to which this organ or a substitute for it is developed; such differences may merely indicate the degree of divergence from a primitive type and may need to be correlated with other characters to indicate dichotomous divisions."

In a study of the scales of the Lepidoptera (the results of which have been elsewhere recorded[2]), a careful examination of the wing-membranes of *Micropteryx* revealed on them, in addition to the numerous specialized scales arranged in regular rows or tiers over the membrane, a covering of very fine hairs, differing radically from the scales in size, arrangement, and mode of attachment to the membrane. These minute hairs are present in all the species of *Micropteryx* I have examined, viz.: *unimaculella, mansuetella, clathrata, anderschella, chrysolepidella, thunbergella, sparmanella, aruncella, fastuosella, seppella, semipurpurella.* And further, are present in all species of *Hepialus* yet examined by me, viz.: *sylvinus, gracilis, humuli, argentata, haydenii, hecta, purpurascens, argenteomaculatus, mcglashani, behrensii* and its variety, *montanus.*

On the other hand, I have yet to discover these minute hairs in any one of the Frenatæ, though I have examined a large number of forms distributed widely over the group. I am convinced that the presence of this clothing of minute hairs on the wing-membranes of the Jugatæ is a subordinal character.

[3]This clothing may be more specifically described as follows: in *Micropteryx unimaculella,* the fore and hind wings on their upper and lower sides are sparsely covered with fine, curving, pointed, short hairs, not inserted in sockets or "insertion cups," as are the scales, and not easily rubbed off. These hairs average .005 millimeters in length, and are distant from each other at their bases a length approximately equal to the length of the hairs. The scales of *unimaculella* average from .1 to .15 millimeters in length.

In *Hepialus sylvinus* the wings are similarly covered with fine hairs, averaging from .02 to .03 millimeters in length. The scales of *sylvinus* are from .2 to .3 millimeters long, or about ten times the length of the fine hairs, which I shall hereafter refer to as the "fine hairs" or the "fixed hairs."

[2] Kellogg, V. L., The Taxonomic Value of the Scales in the Lepidoptera, pp. 45–89, with 17 figs. and plates IX and X, Kansas University Quarterly, Vol. III, No. 1, July, 1894.

[3] This paragraph and two or three succeeding ones referring to wing-clothing are mostly quoted from my paper on the lepidopterous scales before referred to.

Beyond the availability of the presence of the fine hairs in in the Jugatæ and their absence in the Frenatæ, as a recognition character, the phylogenetic significance of this character seems to me of interest, and if I interpret it aright, especially interesting in the light of Professor Comstock's recognition of two main branches of the Lepidoptera. The Jugatæ, according to Professor Comstock, are the more generalized group of the two. The venation indicates this strongly; *Micropteryx* possesses the most generalized mouthparts to be found among Lepidoptera; and, lastly, the mode of tying the wings together is the same as obtains in many of the Trichoptera, a a group of neuropteroid insects offering many indications of affinity with the Lepidoptera. In addition to these indications, or, indeed demonstrations, of the generalized condition of the group Jugatæ, the clothing of the wings is essentially that of the [4]Trichoptera, only in more specialized state. On the wings of the Trichoptera there is a distinct clothing of fixed hairs, unstriated, not set in sockets, and not easily removed. In addition there is a sparse covering of specialized hairs, striated, set in sockets, easily rubbed off, very long and large compared with the much more numerous fixed hairs, and evidently the lepidopterous scale in generalized state.[5]

The wing-clothing of the Jugatæ is more specialized than that of the Trichoptera in two ways: first, by the degradation of the fine hairs, tending toward that total disappearance which is characteristic of the Frenatæ; and second, by a specialization by addition, in the case of the scales, which have, indeed, reached almost as high a degree of development as is to be found among the Heterocera. This high specialization of the scales in *Micropteryx* and *Hepialus* does not at all indicate a high rank for them among Lepidoptera, but merely is confirmative of the presumption that they are the existing tips of branches whose lower members have disappeared. Nor, in-

[4] I have described and compared the clothing of the wings of the Trichoptera and Lepidoptera, in some detail, in the paper on the taxonomic value of the scales of Lepidoptera (*loc. cit.*).

[5] The beginnings of this kind of wing-clothing are perhaps apparent in the Panorpidæ.

deed, is it necessary to believe that these branches have been long ones, for, as I have elsewhere shown[6], the specialization of scales can come about very rapidly.

It seems probable that the stem-form of the Lepidoptera possessed a wing-clothing much like that now exhibited by the Trichoptera, and that the Jugatæ branched off before the covering of fine hairs had been lost, although the tendency of specialization had already become manifest. The phylogenetic position of the Jugatæ, indicated by their wing-clothing, quite corresponds with that indicated by the wing venation as shown by Professor Comstock.

Another characteristic of the Jugatæ, not so distinctly available as a recognition character, but of considerable phylogenetic significance, is presented by the structure of the thorax.

The thoracic structure of the common, wingless, racial form of the Hexapoda is probably pretty fairly shown by the living Campodeas. With the appearance of wings the musculature of the two hinder segments of the thorax was necessarily largely increased, and those segments increased in size and strength. The chitinous exoskeleton became especially firm and strong for the attachment of the muscles, and the two segments acquired a bulk and form proportional to the extra development of the musculature. In the more generalized of winged insects the two pairs of wings are subequal in size and importance, and are quite independent of each other. Correspondingly, the meso- and metathoracic segments are subequal in size and form. The Paleodictyoptera of Scudder, including all the Paleozoic insects, are credited by him with the following characters (among others): "thoracic segments subequally developed; both wings closely similar in shape and with a simple neuration." The condition of wings and thorax in many of the living generalized neuropteroid insects well illustrates this state. (See fig. 1, plate XVII.)

But the parachute-like function which these broad subequal wings subserved began to give way to a more effective aerial locomotion. A tying together of the fore and hind wings of each side to secure synchronous action, and a

[6] See paper on scales referred to.

cephalization of the flight function, manifested by a reduction of the hind wings and a specialization of the fore wings as strongly supported firm plates for rapidly beating the air obtained. This synchronity of action by the two pairs of wings and the cephalization of the flight function, was accompanied by coincident structural changes in the segments containing the wing musculature. With the loss of independence by the two pairs of wings, and the development of their united action, the meso- and metathoraces became more and more combined until in some cases they are so nearly fused as to form a single strong box for the wing musculature. The cephalization of flight or the reduction of the hind wings and the specialization of the fore wings is accompanied by a corresponding reduction in size and importance of the metathorax, and a marked increase in size of the mesothorax.

The musculature of the legs is also, of course, contained in the thoracic segments, but where, as in the Lepidoptera, the functions of the legs are so largely reduced, so overshadowed by the flight function that the anatomy of the thorax depends almost entirely on the specialization of the wings, and where, as is also the case in the Lepidoptera, the flight function and consequent condition of the wings is of so much [7] importance in the economy of the organisms, it is evident that the testimony borne by the thoracic anatomy should be a contribution of real importance towards a comprehension of the phylogeny of the group.

As a fair example of the lepidopterous thorax in a species certainly not among the more highly specialized Lepidoptera, and admittedly not belonging to the most generalized forms, I have taken the thorax of *Actias luna*. As our interest lies in the meso- and metasegments, being the ones directly connected with the function of flight, I may omit reference to the prothorax.

The scutum of the mesothorax in *luna* (See fig. 2, plate XVII) is the largest sclerite of the dorsum, and presents a greater surface than all the rest of the dorsal sclerites of the meso- and metathorax combined. It is longer than broad, is traversed

[7] See Comstock, *loc. cit.*, p. 51.

by a faint longitudinal median carina, and its posterior border presents a reëntrant angle into which the forward-projecting apex of the scutellum fits. The scutellum of the mesothorax is subtriangular in outline with rounding angles. The dorsum of the metathorax is less than one-third as long as the meso-notum. The scutum is chiefly apparent in its two lateral portions, the median portion being reduced to a narrow transverse bar; the scutellum is a small transversal sclerite with a curving anterior margin. The pleural aspect of the mesothorax is markedly greater than that of the metathorax, but the relation between them does not show such a preponderance of the mesothorax as is shown on the dorsum.

With the specialization of the flight function indicated by a cephalization of flight, including a specialization of the fore-wings and a reduction of the hind-wings, there comes a correlative change in thoracic structure. This may be shown in *Hemaris thysbe*, one of the swift-flying sphinges, with a highly specialized venation. The mesonotum (see fig. 3, plate XVII) constitutes almost the entire dorsal aspect of the thorax, the metanotum being limited to a very narrow transverse bar, dilating laterally to more conspicuous dimensions. The scutum of the mesothorax is almost as broad as long.

Turning now to the Jugatæ, the venation of whose wings, according to Professor Comstock, is the most generalized of any among the Lepidoptera, an examination of the thorax reveals a distinctly generalized condition. In *Micropteryx unimaculella* (see fig. 4, plate XVII) the mesonotum does not exceed the metanotum in length by more than one-half the length of the latter. The general outlines of the dorsum of both segments are much alike, and the scutum and scutellum of the mesonotum resemble the equivalent sclerites of the metanotum in shape. In each segment the scutellum projects forward into an angular emargination of the hind border of the scutum. In the more specialized forms of the Lepidoptera the reduction of the metanotum is accompanied by the narrowing of the median portion of the scutum, until, in many cases, the scutum is divided, apparently, by the scutellum into two lateral pieces.

In *Hepialus humuli* (see fig. 5, plate XVII) the mesonotum is relatively larger, compared with the metanotum, than in *Micropteryx*, and there is correspondingly more of a difference of outline between the two segments, but the thorax is still distinctly a generalized one. The metanotum is about one-half as long as the mesonotum.

Nowhere else among Lepidoptera have I found so generalized a condition of the thorax, as shown by the Jugatæ, unless it be in the Tineina, where, indeed, among all Frenatæ, it would be expected. In *Tinea vestitella* the thoracic structure appears to be in a very generalized state, although the shape of the sclerites differs much from that in the Jugatæ.

An additional point of interest is adduced by a comparison of the thorax of the Jugatæ with that of the Trichoptera. A striking resemblance is apparent, as is illustrated in figures 4 and 6, one being the dorsal aspect of the thorax of *Micropteryx unimaculella*, and the other that of *Hydropsyche phalerata*. This suggests again the affinity of the Lepidoptera, through the Jugatæ, with the Trichoptera.

The patagia of the mesothorax exhibit an interesting specialization following closely the development of the flight function as indicated by the wing venation and the thoracic structure. The patagia probably function as shields or protective coverings for the insertions of the front wings, the thin lobe curving around the base of the fore-wing in a way well calculated to protect this unchitinized and vulnerable portion of the moth's body. In the swift-flying sphinges the patagia acquire a remarkable development, extending posteriorly almost to the hinder margin of the mesoscutum. In the more generalized *luna* the patagia are much less developed, and in the Jugatæ the patagia are very small and inconspicuous. The patagia are present also in the Trichoptera, and are strikingly like the equivalent processes on the Jugatæ.

A careful study of the thorax of the Lepidoptera must certainly be rewarded by suggestive results.

As to the kind of characters which these drawn from the wing-clothing and thoracic structure are, I refer to the paragraph at the beginning of this paper quoted from Professor

Comstock's essay, relating to two kinds of characters; first, characters indicating dichotomous divisions of lines of descent; second, characters indicating degrees of divergence from a primitive type. It is evident that either one of these kinds of characters may be subordinate to the other, although, at first glance, perhaps, it might seem that characters indicating differences in kind of specialization, or dichotomous divisions of descent lines, must always be superior to characters indicating differences in degree of the same kind of specialization. For example, given a dichotomous branching according to characters of the first kind, the forms along either line will be ranged according to characters of the second kind, *i. e.*, differences in degree of specialization along that line. But, in a larger view, there is, in the development of any considerable group of organism, as, for example, the class Insecta, a general tendency of specialization along some pretty distinct main line, or more or less nearly parallel lines. For example, in the Insecta may be adduced the development of the flight function accompanied, in the Lepidoptera, by a cephalization of flight indicated by the specialization of the front wings and a reduction of the hind wings and accompanied also by the specialization of the thorax in the manner pointed out in this paper. Subordinate to any general tendency, such as the development of the flight function, there will appear characters indicating dichotomous divisions of lines of descent, the methods of advance along the line of the general tendency differing in two branches of the group. An example of this is afforded by the Odonata and the Diptera; in one group the specialization of fore and hindwings has followed the same lines, in the other the specialization has resulted in the loss of the hindwings. In both instances a fine development of the flight function has been reached.

Of the kind of characters indicating in a general and large way degrees of divergence from a primitive type, these characters drawn from the wing-clothing and thoracic structures may be looked on.

Explanation of Plate, XVII.

Fig. 1.—Meso- and metanotum of *Corydalis cornuta.*

Fig. 2.—Meso- and metanotum of *Actias luna.*

Fig. 3.—Meso- and metanotum of *Hemaris thysbe.*

Fig. 4.—Meso- and metanotum of *Micropteryx unimaculella.*

Fig. 5.—Meso- and metanotum of *Hepialus humuli.*

Fig. 6.—Meso- and metanotum of *Hydropsyche phalerata.*

In all the figures: *a* = scutum of mesonotum; *b* = scutellum of mesonotum; *c* = scutum of metanotum; *d* = scutellum of metanotum; *p* = patagia = paratera of mesonotum.

Stanford University, California.

RECENT LITERATURE.

The Glacial Nightmare and The Flood.[1]—In these two volumes Sir Henry Howorth undertakes to show how the Glacial Theory, as usually taught, is not sound, that it is based upon hypotheses, some of which cannot be verified, while others can be shown to be false. In facing the solution of the Drift problem be postulates a catastrophe, viz., a widespread flood, to explain the geological phenomena of the Plistocene period, and to account for the extinction of the fauna of that time. The work is limited to a consideration of the so-called drift beds and frequent reference to the literature of the subject is made. The opening chapters are compilations of the arguments advanced and conclusions reached by all authorities of the present century upon the subject, and many who date from the middle of the last. The second volume discusses the inadequacy of ice to meet the calls made upon its working power by the glacialists, with a concluding chapter in which the author claims that the only explanation of the distribution of the drift is a great diluvial catastrophe, and he points out in detail how the many facts of the drift are in accord with this theory. Examples are cited of the distribution by rapidly moving water of erratics, and also of the production of striæ by the latter. In some cases these striæ are seen on the blocks transported by the water, and again upon the surfaces over which the detritus has been impelled.

An important omission in the chain of evidence presented by Mr. Howorth, in favor of his theory, is the *cause* of the flood. Save for a brief reference in his preface to "the rapid and perhaps sudden upheaval of some of the largest mountain chains in the world, accompanied probably by great subsidences of land elsewhere," there is no reference to this point, upon which the whole theory seems to rest.

Life Histories of North American Birds.[2]—This work is one of a series in quarto form intended to illustrate the collections in the U. S. National Museum. The present volume relates only to land birds, and while the main object is to make it a systematic and com-

[1] The Glacial Nightmare and The Flood. 2 vols. By Sir Henry H. Howorth. London, 1893. Sampson Low, Marston and Co. Publishers.

[2] Life Histories of Birds, with special reference to their Breeding Habits and Eggs. By Charles Bendire, Captain, U. S. A. Special Bulletin No. 1, U. S. Natl. Mus. Washington, 1892.

prehensive work on the oölogy of North America there is incorporated in the text the latest information as to the life history, the migratory and breeding ranges, and the food of each species. The classification given in the Code and Check List of the American Ornithologists' Union has been followed.

The illustrations comprise 12 chromolithographic plates, reproduced from water-color drawings of eggs belonging to the collections in the U. S. Natl. Museum.

The long residence of Capt. Bendire in the far west, has given him exceptional opportunities for observing the habits of the birds. He describes them in a most interesting manner, and he weaves into his narratives some glimpses of military life, and frontier adventure, which add an especial flavor to the book.

Geology of the Coastal Plain of Alabama.[3]—Under this title Mr. E. A. Smith presents a report which embodies the results of a thorough study of the Cenozoic formations of the Coastal Plain of Alabama. Part I is substantially a republication of Bull. 43 U. S. Geol. Surv. with some additions and slight alterations, followed by a full report by D. W. Langdon of the variations of the Eocene and Cretaceous formations in the territory between the Alabama and Chattahoochee rivers, together with a account of his discoveries of the Marine Miocene formations at Chattahoochee and Alum Bluff in Florida. Part II deals with the various phosphatic marls, green sands, etc., occurring in this part of the state. Part III, includes county descriptions in detail.

The series of Marine Eocene and Cretaceous formations is exposed along the Alabama rivers more fully than anywhere else in the Eastern States, and the scale here illustrated will serve as a standard for other regions.

Thirteenth Annual Report of the U. S. Geological Survey for 1891–'92. Part II.[4]—The report of the Director for 1891–'92 is published in three parts, of which Part II is devoted to Geology and comprises the following papers: Second Expedition to Mt. St. Elias including an account of the Malaspina Glacier, by Israel Cook Russell; The Geological History of Harbors, by N. S. Shaler; The Mechanics

[3] Report on the Geology of the Coastal Plain of Alabama by E. A. Smith, L. C. Johnson and D. W. Langdon, Jr. With Contributions to its Paleontology by T. H. Aldrich and K. M. Cunningham. Montgomery, Alabama, 1894.

[4] Thirteenth Annual Report of the United States Geological Survey, 1891–'92, Pt. II, Geology; Pt. III, Irrigation. By J. W. Powell. Washington, 1893.

of Appalachian Structure, Bailey Willis; The Average Elevation of the United States, by Henry Gannett; The Rensselaer Grit Plateau in New York, by T. Nelson Dale; The American Tertiary Aphidæ, by Samuel Hubbard Scudder.

The same report, Part III, constitutes the fourth in the series of reports of the Irrigation Survey. The water supply for irrigation is discussed by Mr. E. H. Newell, special attention being given to the drainage basins of the Missouri, the Yellowstone and the Platte rivers. The principal features distinguishing American irrigation engineering are described by Mr. H. W. Wilson, together with the engineering results obtained by the Irrigation Survey. Two topographic reports relating to the location and survey of reservior sites are contributed by Mr. A. H. Thompson. The various reports are abundantly illustrated.

Reports of the Geological Survey of Arkansas for 1891 and 1892.[5]—These two Reports representing Vol. II of the Survey are bound in two separate books. The report for 1891 comprises papers on the work accomplished by the Survey by Branner, Simonds, Hopkins, and Siebenthal. In addition are Miscellaneous Reports on the fauna of the state, magnetic observations and bibliography of the Geology of Arkansas to date.

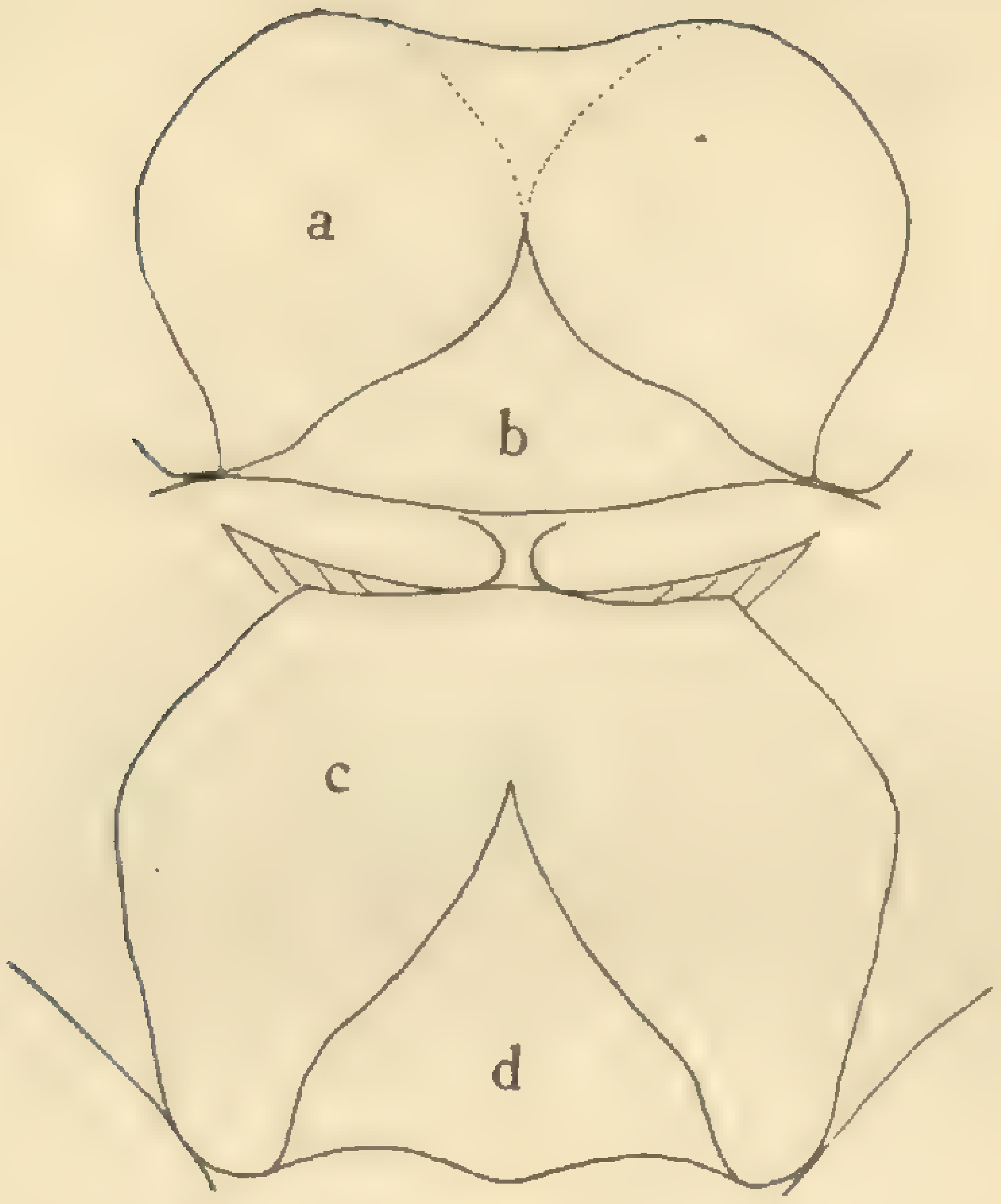
The report for 1892[6] embraces the work undertaken by the Survey for the purpose of distinguishing the subdivisions of the Cenozoic formation of Arkansas and for determining their areal distribution in the southern part of the state. This work was accomplished by Prof. G. D. Harris. Both Reports are illustrated with a number of well executed plates.

[5] Annual Report of the Geological Survey of Arkansas for 1891. Miscellaneous Reports, 1894.

[6] Annual Report of the Geological Survey of Arkansas for 1892. Tertiary Geology of Southern Arkansas, 1894.

PLATE XVII.

1



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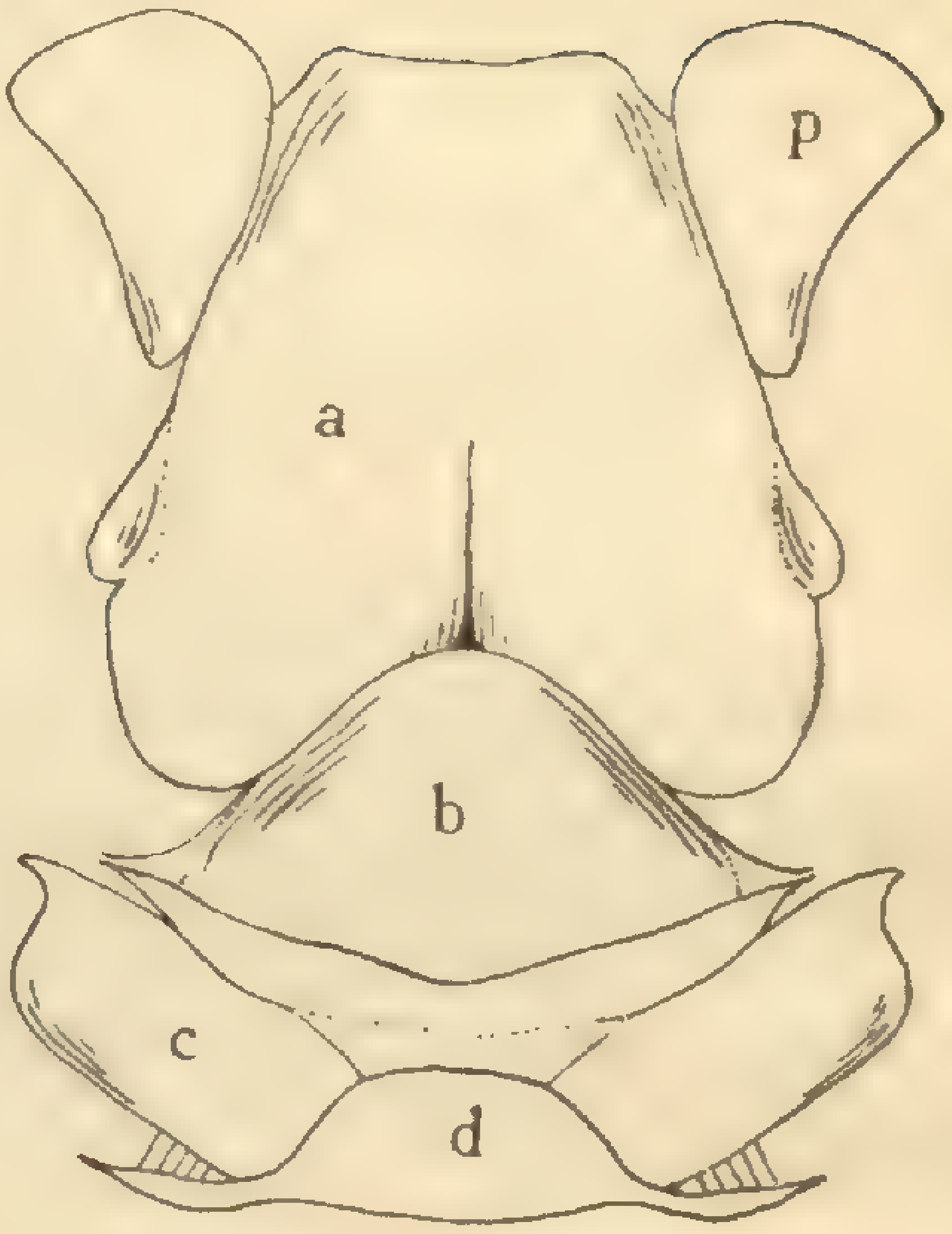

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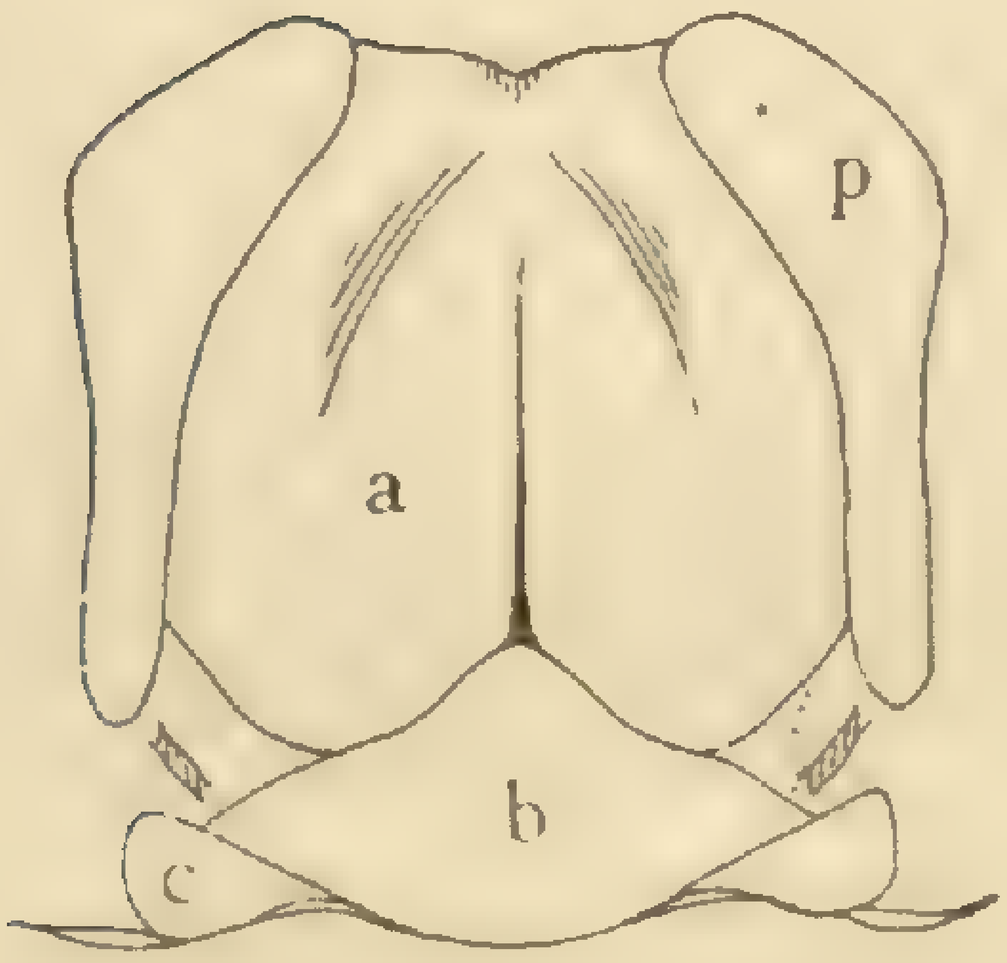

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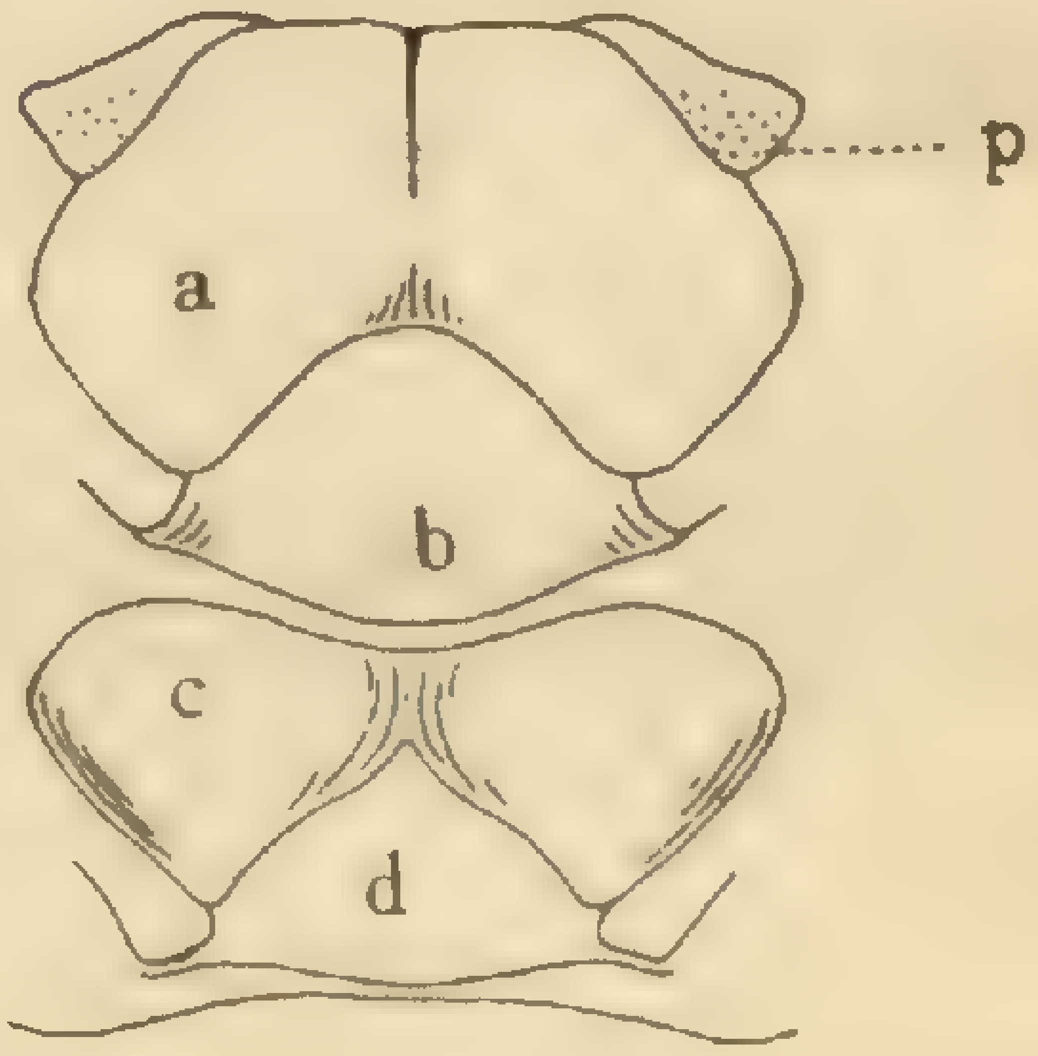
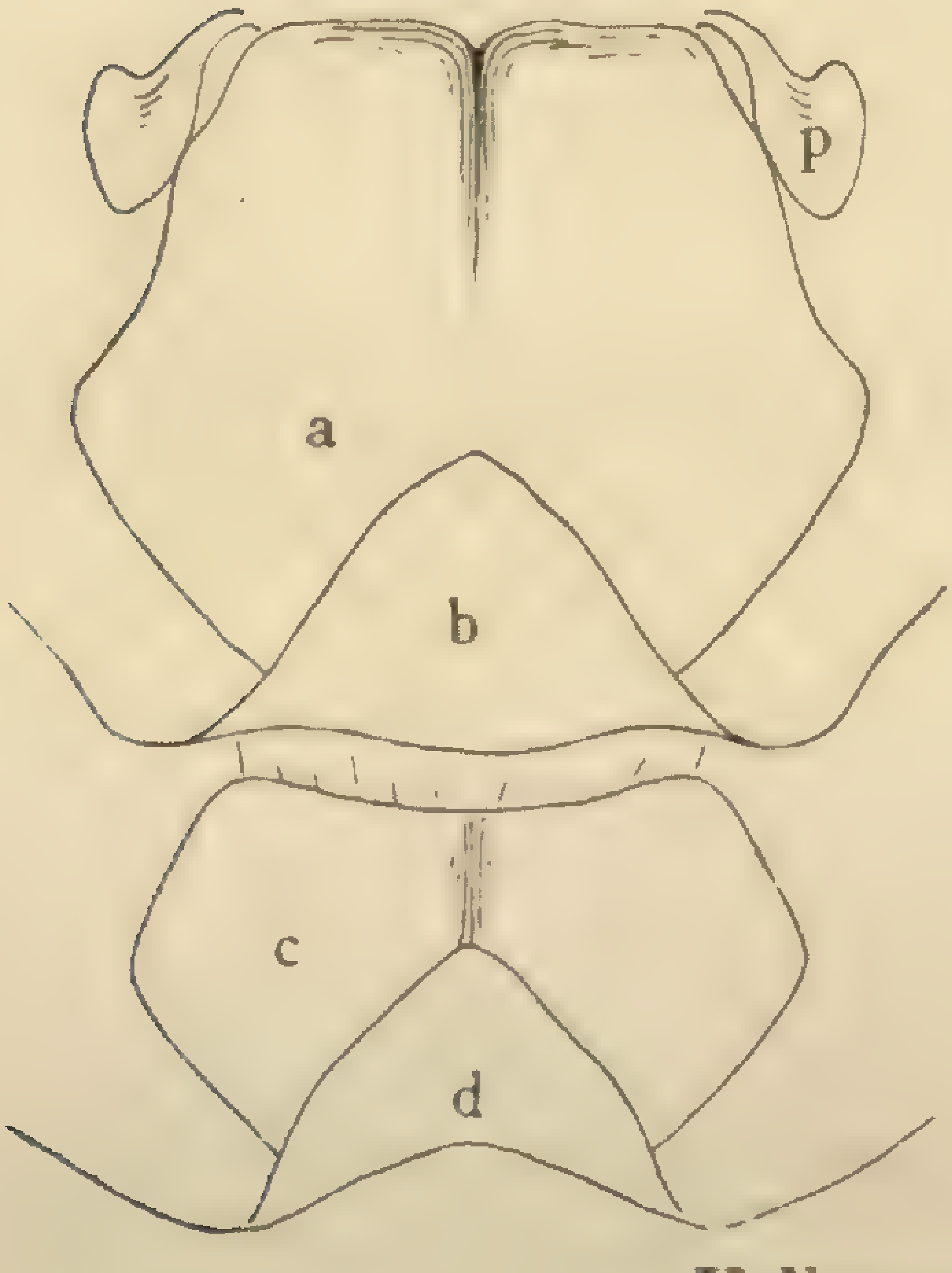
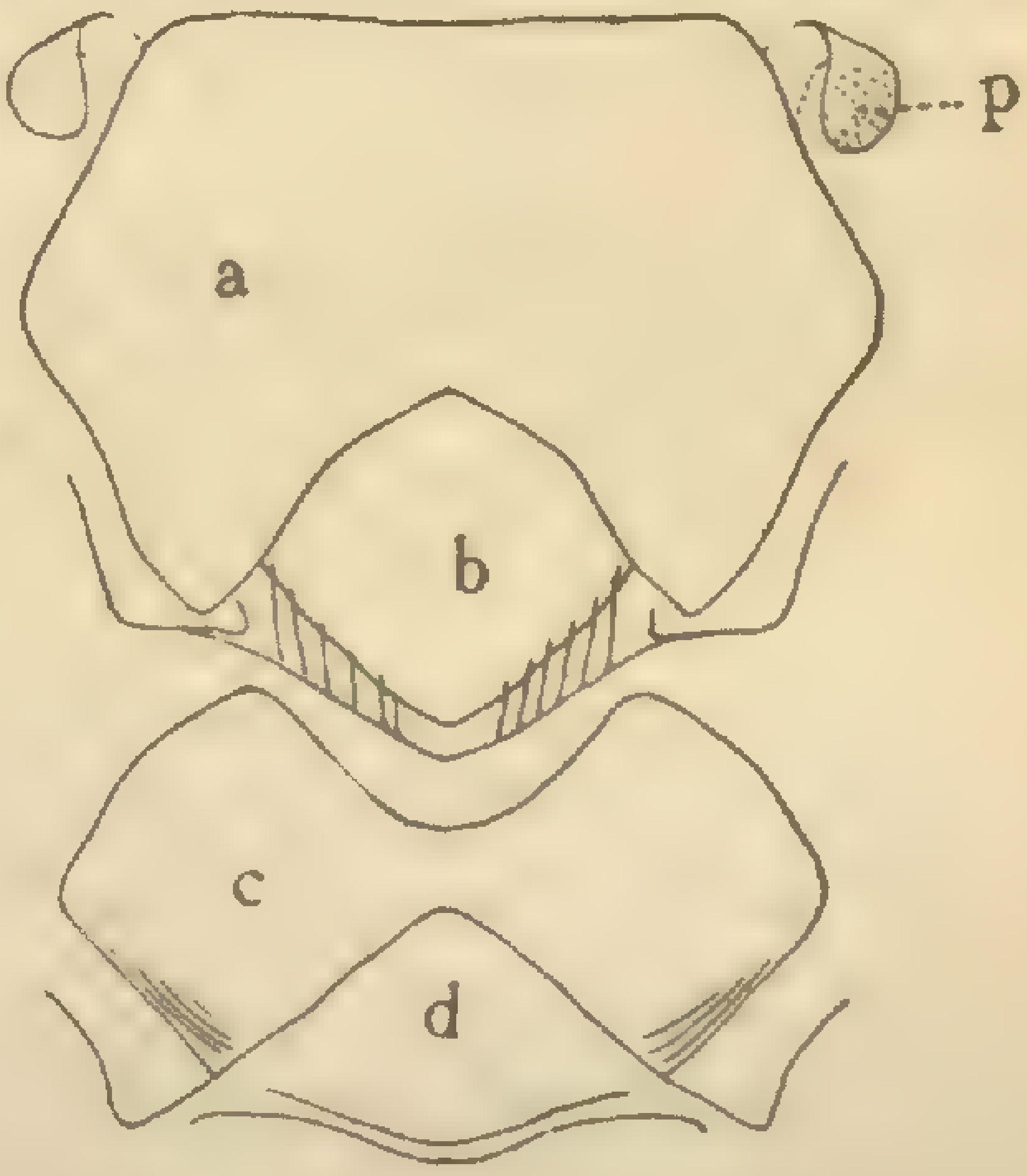


5



6



Kellogg on Lepidoptera.

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General Notes.

GEOGRAPHY AND TRAVELS.

African Volcanoes—In 1891, when Emin Pasha started west from Victoria Nyanza on the journey that ended in his violent death, he and his comrade, Dr. Stuhlman, were the first white men to see the big mountain Mfumbiro, 120 miles from the lake which Captain Speke, many years before, had placed on his map on native information. They found that the Mfumbiro was not an isolated cone, but the most eastern of a hitherto unknown range of volcanic origin. Their first purpose was to determine the outlines of Lake Albert Edward, and they did not stop to explore these mountains; but Dr. Stuhlman sent home an interesting report of the natives that Virunga, the most western summit of the chain, was a fire mountain, from whose top smoke was often seen to issue, and from which noises were heard like the bellowing of cattle.

On December 8th a cablegram reached Europe from Count von Gotzen, the German explorer, announcing his arrival on the lower Congo, after crossing Africa from east to west. About the same time a letter he had written in Central Africa, in June last, arrived. It contained brief but interesting detail of his visit to Mount Virunga. There have been reports of plutonic activity among the Rif Mountains in northwestern Morocco, but the hostile natives have prevented investigation. The subterranean forces that formed the great trough and piled up mountains of lava and ashes east of the great lakes show, by solfataras, hot springs and other phenomena, that they are not yet entirely spent. But until the discovery of Mount Virunga, no active volcano was known to exist in Africa.

While still far away Count von Gotzen saw a thin column of smoke ascending from the principal crater, and later he found that the rim of this orifice is 11,400 feet above the sea. The volcano, therefore, is not a snow mountain, and is not so tall as its nearest neighbor on the east, which, according to Stuhlman, is about 13,000 feet high. It took von Gotzen several days to force a passage through the dense forest and to scale the steep mountain side. At last he stood upon the edge of the crater and looked down upon a most interesting spectacle.

The crater is about a mile in diameter, and the top of the encircling wall on which the explorer stood, is about 160 feet above the crater floor. The inner side of the wall was too steep for comfortable descent, and, in view of what was going on at the bottom, there was absolutely no temptation to make the journey.

The yellow-hued bottom of the crater floor was as smooth as the surface of a lake, and the explorer believes he was looking down upon an expanse of molten lava. Above this smooth surface rose the walls of two orifices, which was over 300 feet in diameter; a small volume of smoke was issuing accompanied by a noise that sounded like the roll of distant thunder. There were unmistakable indications that outside of this crater another center of eruption exists on the west side of the mountain, but the explorer was unable to push through the woods to reach it.

For some years a little lake has appeared on the maps some distance south of the place this volcano has been found to occupy. It is Lake Kivu, seen by no white man until von Gotzen stood on its shores soon after he had looked down in the smoking crater. He says the lake stretched away before him like a sea, and, though it was a clear day, he could not see its southern shores. He believes the lake is almost as large as Lake Albert Edward. Its outlet is supposed to be the Rusisi River, which enters the north end of Lake Tanganyika.

It is too early to regard the large prizes of African discovery as all won when such interesting and important results reward research, as those attained by the latest traveler across Africa. (From N. Y. Sun in Scientific American, Jan. 5, 1895).

MINERALOGY.[1]

New Instruments.

Goniometer with two Graduated Circles.—Goldschmidt[2] has devised a new form of goniometer which he has called *Goniometer mit zwei Kreisen.* Besides the horizontal graduated circle there is in this instrument a vertical graduated circle, and it is this circle which is fitted with the usual centering and adjusting support for the crystal. The vertical circle and its attachments are supported by an arm which revolves about the axis of the horizontal circle. The collimator and telescope are constructed as in the goniometer with horizontal circle, and for measurement are so placed that their axes make equal angles with the zero position of the revolving arm and movable axis. The crystal is adjusted for the prism zone and brought into the unmovable axis of the instrument. The pole of any face of a crystal is located in the same manner as a point of the earth's surface by latitude or longitude, or a star by right ascension or declination. To determine a plane *by reflection* the adjusted crystal is revolved about the movable axis (vertical circle) till the face is perpendicular to the plane of the horizontal circle (φ). The movable arm is then revolved about the unmovable axis until the face is normal to the zero position of the arm—makes equal angles with the axes of collimator and telescope (ς)—when the image of the signal will appear on the cross hairs of the telescope. The position of a plane can also be determined by the angles through which it is necessary to turn it to make it appear as a line parallel to one of the cross hairs of the telescope. The inventor claims for the instrument, among other advantages over the forms in use, that measurements are more quickly and conveniently made, and that the calculation of crystallographical constants and symbols and the making of projections are much simpler. It is necessary to mount the crystals but once for the entire measurement, and pyramid planes require but a single adjustment. The position of a face is determined without reference to the perfection of its neighbors. Angle tables can be constructed corresponding to a definite setting of the crystal which allow the symbol to be obtained at once from the angles φ and ς, and thus comparison of differently developed crystals can be easily made.

[1] Edited by Dr. Wm. H. Hobbs, University of Wisconsin, Madison, Wis.

[2] Zeitsch. f. Kryst., xxi, pp. 210–232, 1893.

Universal Goniometer.—A very similar instrument to the Goldschmidt goniometer just described is the *Universal goniometer* invented by von Federow.[3] In this instrument the telescope is also the collimator, the signal being located in the side of the telescope and its image reflected to the crystal face by means of a prism. When the face is normal to the axis of the telescope the image is reflected back over its own path and brought to a focus on the cross hairs which are located just behind the prism. The credit for priority in the important invention of the goniometer with two circles, and the method of measuring crystals by the location of the poles of their faces, clearly belongs to v. Federow, as a short description of his instrument was published in the Russian language in 1889.[4] It is impossible in this space to review so important a paper as the one under consideration. It is a treatise of some 140 pages on the calculation and projection of crystals from measurements with the universal goniometer. It contains suggestions for the renaming of crystal forms and the modification of the Miller's symbols in the interests of greater uniformity in the system.

Miers's Inverted Goniometer.—Miers[5] has modified the Fuess goniometer with horizontal circle in such a way as to have the crystal held at the lower instead of the upper end of the axis of the instrument, and hence below the disc. The crystal may be measured immersed in a liquid which is contained in a rectangular trough with plate glass sides. The collimator and telescope tubes are placed at right angles to one another, their axes being also normal to adjacent sides of the trough. The liquid in the trough may be a concentrated solution of the crystal's substance, so that changes in the form of the crystal during growth may be observed and measured. The trough is supported on a small table which can be raised or lowered at will. Some very important observations which Miers has made with this instrument will be reviewed in another place.

New Goniometer Lamp.—Goldschmidt[6] describes a new goniometer lamp which he has found useful also for photo-micrographic work. The burner is an Auer or Welsbach burner (Auer'sche Glühlicht) which is specially suited to the purpose because of its strong and

[3] Zeitsch. f. Kryst., xxi, pp. 574–714, 1893.

[4] Verhandl. k. mineral. Gesellsch. St. Petersburg, xxvi, pp. 458--460. November, 1889.

[5] Nature, l, pp. 411--412, Aug. 23, 1894.

[6] Zeitsch. f. Kryst, xxiii, pp. 149-151, 1894.

steady character and its low temperature. The burner with its glass chimney is enclosed in a cylindrical mantel constructed of brass and sheet iron, in which are inserted two horizontal tubes perpendicular to one another and at the level of the brightest part of the light. One of these tubes serves to illumine the signal, while through the medium of an arm carrying a mirror on a universal joint the light from the other tube may be thrown at will on the crystal, the vernier, or the paper.

Darkening Attachment for the Goniometer.—Traube[7] has devised a very simple attachment for the Fuess goniometer with horizontal circle by means of which the crystal under measurement is protected from all light except that which comes from the collimator. The attachment is easily adjusted and quickly removed, and is so effective that measurements may be made at any hour of the day in an undarkened room. The frequent alternation of light and darkness which is so trying to the eye can thus be avoided.

Lecture Microscope.—Fuess[8] has designed a simple form of petrographical microscope adapted to the lecture room, where it can be passed from hand to hand by the students. With full set of accessories the instrument costs in Germany 158 marks.

Czapski's Ocular.—Czapski[9] considers the attachments on petrographical microscopes which have been devised for quickly changing from parallel to convergent polarized light, as quite unnecessary complications of the instrument, since the same results can be obtained by the use of the modern iris diaphragm below the condenser. To observe the interference figure of a very small crystal which only partially covers the field of the microscope, Czapski's method is to bring the crystal as near as possible to the middle of the field, remove the ocular, and place a diaphragm with small aperture over the microscope tube. With the aid of a weak lens one sees within this aperture the real image of the crystal. The crystal is now brought more accurately to the centre so that it occupies all of the now diminished field. Removing the lens one sees the best possible interference figure from the crystal.

He has devised specially for this work an ocular with an iris diaphragm at its lower end and an easily removable lens or a Ramsden's ocular above.

[7] Neues Jahrb. f. Mineral., etc., 1894, (ii), pp. 1–2.

[8] Neues. Jahrb. f. Mineral., etc., 1894, (ii).

[9] Zeitsch. f. Kryst., xxii, pp. 158–162, 1894.

Klein's Lens with Micrometer.—Becke[10] has designed an attachment to fit over the Czapski ocular like the common form of analyzer, to determine the size of the optical angle in very small crystals when the section is approximately normal to a bisectrix (Mallard's method). This device has fitted into its upper part, so as to be adjustable by friction, an aplanatic lens magnifying eight times. Below this is an ocular micrometer which can be raised or lowered by means of two heads on the outside of the attachment. The interference figure observed with this instrument is not the one obtained by the objective alone but the one formed in the upper eye point of the microscope above the Ramsden's ocular. Before using the attachment the minute crystal is centered and the diaphragm of the Czapski ocular closed until the crystal alone is visible. The Klein lens is now adjusted over the ocular till the objective diaphragm is visible, when the interference figure may be distinctly seen. The micrometer is now adjusted to read without parallax. The constant K of the combination (in Mallard's formula $\sin\delta = K. d$) for a given length of tube is obtained by measuring d in the case of several sections normal to a bisectric whose optical angle has been determined by an axial angle apparatus. The attachment can also be used to measure the azimuth of any point in the interference figure with reference to cleavage or twinning line, etc. The long middle line of the micrometer is placed in the azimuth of the point to be determined. On introducing the Bertrand lens and slightly altering the length of the tube the image of the section appears. The stage is now revolved until any direction desired is brought parallel to the micrometer line and the angle measured. This device is useful to determine the changes in optical orientation in different parts of a crystal individual and to determine the position of the optic axes in the twinned lamellæ of the plagioclases.

Wm. H. Hobbs.

[10] Min. u. petrog. Mittheil., xiv, pp. 375–378, 1894.

GEOLOGY AND PALEONTOLOGY.

Relations of Devonian and Carboniferous Faunæ.—Prof. H. S. Williams calls attention to the recurrence of Devonian fossils in strata of Carboniferous age in northwestern Arkansas. The fossils occur in a limestone formation, about the equivalent of the Warsaw or St. Louis formations of Missouri, and referred to the lower third of the Carboniferous. Among the undoubted carboniferous forms occur numerous specimens of *Liorhynchus quadricostatum* Vanuxem and *Productella lachrymosa* var. *stigmata*, *onusta*, etc., Hall. The entire fauna is closely allied to that of the Eureka District, Nevada, and of Shasta County, California, and the author accounts for the appearance of these Devonian species in the Arkansas Carboniferous rocks as a case of migration from the region where they had been living unchanged. This migration was brought about by an elevation of the western area sufficient to cause a diversion of ocean currents and the shifting of such species as endured the transport into the Mississippi Valley.

In conclusion, Prof. Williams points out that during late Devonian and early Carboniferous time in the Appalachian province, diversity and alteration of deposits is marked by numerous successive and distinct faunas, in the western continental province uniformity of prevailing calcareous sedimentation for long periods is marked by an abnormally long continuance of many of the Devonian species, while the central continental province, midway between the two, is marked by the recurrence of Devonian species far up in the midst of Carboniferous sediments. This series of observations is confirmatory of the hypothesis that persistence of species without modification is associated with continuance of uniformity of conditions of environment, and that change in the successive faunas of geological time is associated with the change and rearrangement of the conditions of environment to which the fauna is subjected. (Am. Journ. Sci., Feb., 1895.)

Characters of Glossopteris.—A fortunate discovery of a specimen of Glossopteris, a fossil plant associated with the coal-bearing rocks of the southern hemisphere, near Mudgee, N. S. W., shows the attachment of the fronds to the caudex, bringing to light the following facts:

The leaves were successively developed along the whole course of the stalk and were deciduous. They were both petiolate and sessile.

The leaf scars were ovo-rhomboidal, and to each there appear to have been three bundles of vessels.

In consequence of this discovery, Mr. Etheridge reviews the history and structure of Glossopteris, giving its range in Australia, and points out its relation to allied genera. (Proceeds. Linn. Soc. N. S. W., Vol. ix, 1894.).

Geological History of the West Indies.—Mr. Charles T. Simpson gives a brief history of the West Indian archipelago since Eocene times, basing it upon a study of the molluscan fauna of that region. He premises his remarks with the statement that a considerable portion of the land snail fauna of the Greater Antilles seems to be ancient and to have developed on the islands where it is now found, while that of the Lesser Antilles has resulted from migration mostly from South America. The distribution of the terrestrial and fluviatile molluscan fauna is carefully worked out and presented in tabular form. From the facts collated the author deduces several interesting conclusions which he recapitulates in the following form.

"There appears to be good evidence of a general elevation of the Greater Antillean region, probably some time during the Eocene, after most of the more important groups of snails had come into existence, at which time the larger islands were united, and there was land connection with Central America by way of Jamaica and possibly across the Yucatan Channel, and there was then a considerable exchange of species between the two regions. At some time during this elevation there was probably a landway from Cuba across the Bahama plateau to the Floridian area, over which certain groups of Antillean land molluscs crossed. At this time it is likely that the more northern isles of the Lesser Antilles, which seem to be volcanoes of later Tertiary and Post-Pliocene date, were not yet elevated above the sea, or, if so, they have probably been submerged since. After the period of elevation there followed one of general subsidence.

"During this the island of Jamaica, as the character of its land snail fauna shows, as well as the depth of the channel between it and Haiti, was first to be isolated, then Cuba, and afterwards Haiti and Puerto Rico were separted. The connection between the Antilles and the mainland was broken, and the Bahama region, if it had been previously elevated above the sea, was submerged, the subsidence continuing until only the summits of the mountains of the four Greater Antillean islands remained above water. Then followed another period of elevation, which has lasted, no doubt, until the present time,

and the large areas of limestone uncovered (of Miocene, Pliocene and Plistocene age) in the Greater Antilles have furnished an admirable field for the groups of land snails that survived on the summits of the islands. The Bahamas have appeared above the surface of the sea, either by elevation or growth, and have been peopled by forms drifted from Cuba and Haiti, and a number of land and fresh-water species have been recently colonized in South Florida, probably since the Glacial epoch. (Proceeds. U. S. Natl. Mus., Vol. xvii, 1894.)

Fossil Mammals of the Lower Miocene White River Beds.—A part of the collection made in 1892 for the American Museum at New York by Dr. Wortman, has been made the subject of a paper by the collector in conjunction with Prof. Osborn of Columbia College. The novel points presented are :

1. New characters of the Lower Miocene Rhinoceroses, including two new types, *A. trigonodum* and *A. platycephalum.*
2. The osteology of *Metamynodon.*
3. The basioccipital characters of *Oreodon* as developed in successive horizons.
4. The determination of two species of Anthracotherium, and additional characters of the American *Hyopotamus.*

An importantant adjunct to the paper is a tabular statement of the succession of species in the White River Miocene. (Bull. Am. Mus. Nat. Hist., 1894.)

Geological News.—Archean.—According to Prof. H. P. Woodward, the Archean rocks are more largely developed in Western Australia than in any other portion of the world. The series is highly contorted, being folded into a number of parallel folds striking north and south. These folds form naturally six distinct belts which differ in the character of the rocks. Beginning at the west, the first belt is composed of comparatively soft rocks, intersected by dikes of diorite and granite, and veins containing lead, copper, zinc and iron. The second belt is of hard, crystalline rocks also intersected by granite dikes, and but few mineral bearing veins. The third is a granite belt, absolutely destitute of mineral veins. The fourth, fifth and sixth are rich in gold, iron and copper. (Geol. Mag. Dec., 1894.)

Paleozoic.—According to Mr. Walcott, the oldest Cambrian fauna known in western United States is found in the White Mountain range of Inyo County, California, where the author traced a coral

reef (Archæocythinæ) for nearly thirty miles. (Am. Journ. Sci., Feb., 1895.)

Prof. N. H. Winchell considers the Galena limestone only a phase of the Trenton, intensified in the typical locality, and fading out in all directions. The physical break and faunal change which follow it in the northeast are the probable parallels of those which mark the transition from the Trenton to the Hudson River. (Am. Geol., Jan., 1895.)

A specimen of the new fossil shark, *Cladodus clarkii*, recently fonnd in the Cleveland shale of northern Ohio shows the dentition in a remarkable manner by reason of some fortunate fractures. The new specimen confirms most of the characters previously published, and adds a few not discoverable in former fossils. It is described and figured by Prof. Claypole. (Am. Geol., Jan., 1895.)

Recent examinations of the "elephant rock," occurring in various parts of the Transvaal prove it to be a dolomite. Mr. Draper, to whom the rocks were submitted, states that this dolomite is of great extent in the Transvaal and Namaqualand, and he is of the opinion that the limestone tufa, now occupying large areas in the drainage basin of the Vaal and Orange Rivers, are derived from the dolomite. (Quart. Journ. Geol. Soc., Nov., 1894.)

BOTANY.

Some Botanical Collections.—That most valuable distribution, Ellis and Everhart's "North American Fungi" has recently completed its thirty-second century, carrying the total number of specimens up to 3200. On looking over the alphabetical index one notes especially that this century includes of *Cercospora*, 8 species; *Cylindrosporium*, 3; *Glœosporium*, 3; *Microsphæra*, 2; *Phyllosticta*, 5; *Puccinia*, 5; *Septoria*, 6; *Uredo*, 3; *Uromyces*, 2; *Ustilago*, 1.

The uniform, and well-known excellence of the specimens in this distribution, needs no further words of commendation here. Those who can not obtain this set should hasten to secure the second edition which bears the name of "Fungi Columbiani."

F. S. Collins, Isaac Holden and W. A. Setchell propose soon to begin the publication of North American algæ under the title of "Phycotheca Boreali-Americana." The first fascicle of 50 specimens will contain species of *Oscilliaria, Lyngbya, Calothrix, Monostroma, Ulothrix, Drapanaldia, Rhizoclonium, Caulerpa, Lemanea, Chondria, Polysiphonia, Microcladia,* etc. It is intended "to include all families of algæ, both fresh-water and marine, except that no provision has yet been made for diatoms, desmids or charads," but the authors state that these "may be included later." This work will be truly North American, including the whole continent and its adjacent seas from the Arctic Ocean to the Isthmus of Panama, and the West India Islands. The low price (five dollars per fascicle) places it within reach of every college botanical department. Those interested should apply to Frank S. Collins, Malden, Mass.

Josephine E. Tilden of the University of Minnesota has begun the distribution of the fresh-water algæ of the upper Mississippi Valley. It will be important as supplying for the first time a series of these plants from a new region. For century I the price is ten dollars.

The Flora of Amador, Calaveras and Alpine counties, California, is offered to the public in sets of prepared specimens at seven dollars per hundred by George Hansen of the Experiment Station at Jackson, California. The sets are said to contain many varieties and novelties.

Professor F. L. Harvey, of Orono, Me. proposes to issue sets of the Weeds and Forage Plants of Maine, embracing about 300 species. They are intended especially for the use of schools and "granges", and are sent out mounted and labeled. The moderate price (ten dollars per

hundred) should place them in every high school in Maine, as well as in the herbaria of many of the agricultural colleges in other states.

Professor Penhallow, of Montreal, Canada, has prepared a "Type Series of North American Coniferæ," consisting of microscopical sections of the wood, stained, and mounted in balsam. Each species is represented by transverse, radial and tangential sections. The series contains 264 slides and is sold at $120.00. It is the outgrowth of studies made by Professor Penhallow upon North American Conifers looking to a classification based upon the anatomy of the wood. The results of these studies are to be published shortly, and will add to the interest of the prepared specimens.

We have already noticed A. H. Curtiss's "Second Distribution of Plants of the Southern United States," of which Series I and II are now ready. (February NATURALIST).

Fascicle I of Arthur and Holway's "Uredineæ Exsiccatæ et Icones" gives promise of being a most valuable addition to the carefully studied sets of plants now offered to botanists. The specimens are excellent and the drawings very carefully made. A feature which is to be commended is the uniform magnification throughout the series. In the present fascicle seventeen species, are represented by thirty-one specimens and one hundred and thirty-five figures. When supplied in loose packets the cost is to be three dollars per fasicle, when in bound volumes, fifty-cents more.

Many botanists have in the past few years received the neatly prepared sets of lichens sent out by C. E. Cummings and A. B. Seymour under the title of "Lichenes Boreali-Americani," of which about 150 numbers have been received. Hereafter T. A. Williams will aid the editors named above. This distribution has been so well patronized that a second edition has been prepared.

Professor Underwood's "Hepaticæ Americanæ," constitutes the only recent set of North American liverworts. Although no specimens of this distribution have been received for some time we trust that it is to continue.

The distribution of North American Characeæ ("Characeæ Americanæ Exsiccatæ") by Dr. T. F. Allen, of New York City (No. 10 East 36 St.) possesses unusual value, since it probably represents more than any other the immediate results of a critical revision of the species. A recent fascicle contains twelve species mainly of the genus *Nitella*. With these American species there were distributed seventeen Japanese species and varieties under the title of "Characeæ Japonicæ Exsiccatæ,"

among which were several of the new species recently described in the *Torrey Bulletin*.

All mycologists who are familiar with the excellent specimens of Sydow's "Uredineen," (published in Berlin), which has now reached its eighteenth fascicle, (900 specimens) will welcome the beginning of a new set by the same author devoted to the *Ustilagineæ*. Fascicle I of this new set "Ustilagineen," containing fifty specimens appeared within a few months.

We should not overlook here the two centuries of "New York Fungi" published by C. L. Shear, heretofore noticed in this journal. The excellence of the specimens commends this collection, especially to those who are beginning the study of the larger fungi (*Hymenomycetæ*) to which it is mainly devoted. We understand that Century III is nearly ready for distribution.

Nor must we omit the useful "Economic Fungi" published by A. B. Seymour and F. S. Earle, of which seven fascicles (of about 50 species each) have appeared. The work deserves to be successful.

We do not know whether the "Uredineæ Americanæ," of which one fascicle was issued a year or so ago by M. A. Carleton, is to continue or not. It certainly made a good beginning.

We may add to the foregoing the distribution of "Canadian Lichens," and "Canadian Mosses" by John Macoun of the Canadian Geological Survey, which contain good specimens, neatly prepared and often of much interest on account of the region from which they were obtained.

Verily the tribe of makers of exsiccati is a numerous one, and were we to include all those devoting themselves to supplying plants of particular regions, it would be increased three or four fold.—Charles E. Bessey.

Some Recent Botanical Papers.—Dr. T. F. Allen's valuable work, "The Characeæ of America," has made progress by the issuance of another fascicle containing descriptions and illustrations of nine species of *Nitella* of which three are new to science. Too much praise can not be given to the industrious author, who for love of Science, brings out, from time to time, the successive parts of this first work on a group hitherto little studied in this country.

Ellis and Everhart have added a convenient Analytical Key to their *North American Pyrenomycetes*, which has hitherto lacked that useful portion. The same authors have recently distributed a reprint from the proceedings of the Academy of Natural Sciences of Phila-

delphia (65 pp.) containing descriptions of new species of fungi from various localities. Of these there are Hymenomycetes, 10 species; Pyrenomycetes, 72; Discomycetes, 22; Sphaeropsideæ, 91; Hyphomycetes, 46; or a total of 241.

"The Special Senses of Plants" is the title of a thoughtful and suggestive paper by Dr. J. C. Arthur, published in the Proceedings of the Indiana Academy of Sciences. The author discusses gravity sense, light sense, moisture sense, heat sense, and contact sense. The paper should be read by every teacher, whether he teach botany or not.

Professor Penhallow's paper, "Observations upon Some Structural Variations in Certain Canadian Coniferæ" in the Transactions of the Royal Society of Canada, contains histological discussions pertaining to *Pseudotsuga douglasii, Larix occidentalis, Pinus ponderosa* and *Pinus albicaulis.* It is illustrated by four plates containing nineteen figures.

The always welcome Annual Report of the State Botanist of the State of New York has recently been received. As usual it shows that the flora of a region as well worked as that of New York contains many hitherto undescribed species, mostly of the lower plants, but one flowering plant (a *Carex*) proves to be new.—Charles E. Bessey.

ZOOLOGY.

The Central Nervous System of Teleosts.—In the last number of La Cellule, a preliminary paper by Van Gehuchten on the central nervous system of the trout[1] adds several points of considerable interest to our already large stock of knowledge of the structure of the nervous system of vertebrates as determined by the epoch-making Golgi methods. Its value, and that of other papers by competent students, lies not only in adding so much to the known facts concerning the lower vertebrates, but more especially in the light that it throws upon obscure points in the cerebral structure of the higher animals and of man, where the central organs are so large and complex as to render investigation very difficult and even impossible. The older writers, Stieda, Fritsch, Rabl-Rückhardt, Edinger and others, concerned themselves almost wholly with the homologies of the brain of Teleosts. It was not until 1887 that the Golgi method was first employed with them by Fusari. Since then, Schaper, P. Ramon and Retzius have used it. And, if to their work we add that of Nansen and Retzius on the nervous system of *Petromyzon* and that of v. Lenhossek on that of *Pristiurus*, the list will be almost complete for fishes in general.

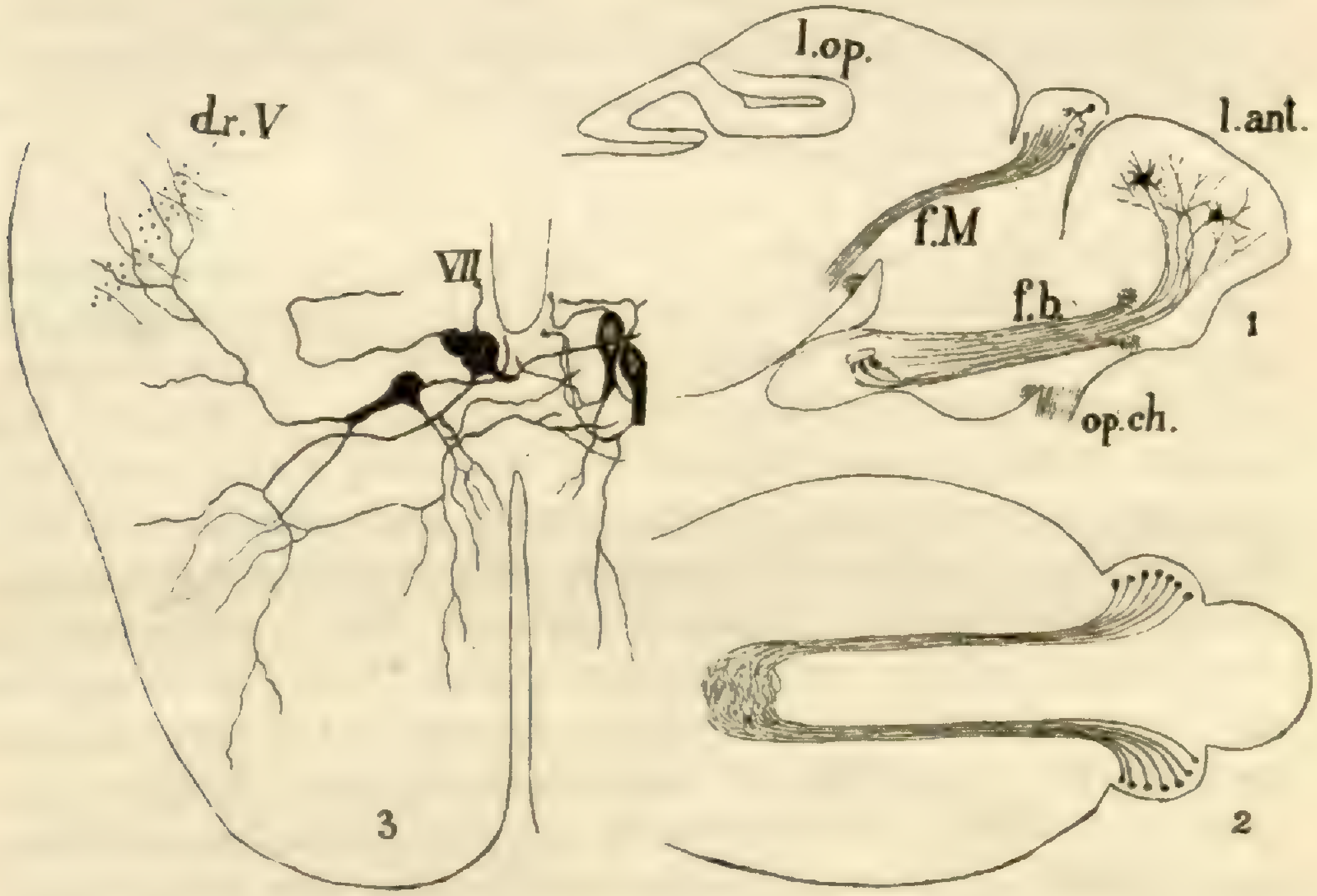
Van Gehuchten takes up (1) the structure of the anterior lobes, which, by the way, are homologous, as shown by Rabl-Rückhardt, with the caudate and lenticular nuclei only of the human brain; (2) the origin of the fibres of the cerebral peduncle; (3) the origin and termination of the fascicle of Meynert; (4) some of the constituent elements of the optic lobes; (5) the origin and termination of the olfactory fibres; (6) the origin of the *oculomotor communis;* (7) origin of the facial nerve; (8) the origin and the peripheral and central terminations of the auditory nerve; (9 and 10) the elements of the Gasserian ganglion, of the trigeminal nerve and of the large ganglion in the course of the pneumogastric, as also of the arrangement of the fibres of these in the cerebral trunk.

Regarding the anterior lobes and the cerebral peduncle, the most important fact brought out is that the latter is composed of both ascending and descending fibres, or, to use the terminology recently proposed by Fish, neurites. The former cannot therefore be regarded with

[1] Le System nerveux des Téléeostéens, La Cellule, Vol. X, pp. 255–95, with 3 pls.

Edinger as merely ganglia for the origin of the peduncular neurites. The interlobular commissures are shown not to be compared with the anterior commissure of human anatomy where merely two opposite lobes are connected. Each of the commissures is composed of neurites that branch off from the basal peduncle and branching cross to and terminate among the protoplasmic processes, or dendrites, of the opposite lobe.

The fascicle of Meynert, which has hitherto been a great puzzle, is explained as being composed of neurites arising from cells in the *ganglia habenulæ* and terminating near the lower surface of the brain in the so-called interpedunculary body. Here they branch profusely,



KENYON ON BRAIN STRUCTURE.

Fig. 1. Longitudinal section of a trout brain passing to one side of the median line.—l.ant., anterior lobes; l.op., optic lobe; f. b., basal fascicle; c. p., cerebral peduncle; f. M., fascicle of Meynert arising from the cells in the ganglion habenulæ; op. ch., optic chiasma, behind which is the commissure of Gudden, and in front of which are the interlobular commissures. Near the fascicle of Meynert is the ansiform commissure.

Fig. 2. The fascicles of Meynert viewed from above, each ending in the interlobular body.

Fig. 3. Transverse section through the nucleus of origin of the facial nerve VII, neurite of the facial nerve; d. r. v., descending root of the fifth with its short collaterals.

mingling with one another, and come in contact with the dendrites and cells of the body. While this explains that the fascicles are composed of fibres of but one kind, nothing is known of the fibres that go to the ganglia habenulæ to complete the circuit. Hence the function of the fascicles is still an open question.

The most interesting point, besides the solution of the structure, origin and termination of the fascicles of Meynert, that appears in the paper, concerns the conductive function of the dendrites. Such a function has been denied them by Kölliker, who still maintains his original ground. His objections are based on the fact, as he states it, of there being protoplasmic processes in certain parts of the white matter of the human brain where they cannot come in contact with nerve endings. Now van Gehuchten shows that in the anterior lobes the ascending or sensory fibres from the basal peduncle terminate freely among the processes or dendrites of the cells of the descending fibres, and that there is no third cellular element between them. And, what is more to the point and of greater weight, he finds that the extremely lengthened dendrites of the cells giving rise to the facial nerve penetrate the descending root of the trigeminal from the neurites of which are given off short, fine collaterals. It has been that shown among Batrachia and elsewhere such means of completing the nervous circuit exists, but Kölliker has persisted in denying any value to these facts when man is considered. The nervous circuit may, he says, be more easily explained without the dendrites. To this van Gehuchten adds that the matter would be still more simple were the collaterals left out. But dendrites and collaterals exist and it is our business to explain them. Moreover, further study of the brain of the higher animals and of man may, and probably will, show that in those places in which Kölliker supposes none to exist, collaterals really occur, and that their not being seen hitherto is to be explained by the difficulties that beset the path of the investigator when he takes up so complex and highly-developed a structure as the human and mammalian brain.

It is with considerable force that van Gehuchten finishes his consideration of the question. From the moment, he says, that any one admits, as one must, the conductive function of the dendrites of the mitral cells of the olfactory bulb, of the cells of Perkinje in the cerebellum, of the cells of the optic lobes in birds, of the ganglionic cells of the retilia, of the pyramidal cells of the cerebral cortex, one may demand upon what decisive grounds any one can find support for a denial of the same function in the dendrites of the medulla.

—F. C. Kenyon.

New Deep Sea Fishes.—A preliminary account of new types of deep water fishes from the northwestern Atlantic is given (Proceeds. U. S. Natl. Museum, Vol. XVII, 1894) by Dr. G. Brown Goode and Tarleton H. Bean. Two new families, Cetonimidae and Rondeletiidae, represented by *C. storeri*, *C. gillii* and *R. bicolor*. The second family is distinguished from the first by the presence of ventral fins, and the incompleteness of the opercular apparatus. Both are Malacopterygian fishes, belonging to the group set aside by Gill under the name Iniomi. Only a single specimen of each species was obtained from depths ranging from 1,043 to 1,641 fathoms.

Another remarkable type belongs to the Chimaeroid group, from the existing forms of which it differs in the extremely elongate, muzzle, and the feeble claspers. Four specimens were obtained, two of them young, and with proportions shorter than those of the adults. The habitat of this genus is given as off the coasts of Virginia, Maryland and Delaware, 707 to 1,080 fathoms. It is described under the name *Harriotta raleighana*.

All the types are figured, and in the next number of the Naturalist, we will reproduce them.

Preliminary Notes on the Osteology of the North American Crotalidae.—I desire to present a preliminary paper giving some characters of the osteology of the *Crotalidae*. I have to thank Dr. O. P. Hay and Mr. M. S. Farr, Fellows in the University of Chicago, for furnishing me specimens for this work. Also, I am under obligations to Dr. George Baur, Assistant Professor in the University of Chicago for special favors and suggestions.

I am able to give both specific and generic characters of the genus Ancistrodon. The species *A. contortrix* was obtaind near Johnstown, Pa., while *A. piscivorus* was secured at Enterprise, Miss. Of the genus Sistrurus I have examined two species, namely, *S. miliarus* from Florida and *S. catenatus* from Indiana. Also I have examined two species of Crotalus, namely, *C. horridus* from Tuscarora Mountain, Pa., and also one specimen from near Johnstown, Pa., and *C. confluentus* collected in Kansas.[1] In addition, we have examined one individual each of *C. horridus* and of *S. catenatus* now in the Museum of Monmouth College. The locality of these specimens is not known.

[1] I have also examined a skeleton in the collection of the Field Columbian Museum, and labelled "*Crotalus durissus* Texas." The identification of this specimen is not at all certain, but it seems to be *C. adamanteus atrox* or *C. molossus*.

Since I have undertaken a more detailed study of these snakes, I omit from this article extended remarks on geographical distribution and specific characters. Neither have I, at this stage of my work, thought best to adopt any system of classification[2].

I desire to make a few general statements. The upper surface of the skull of *Crotalidae,* in comparison with the skulls of other snakes, is quadrate in outline. The interobital region, owing to the elevation of the outer edges of the frontals and outer anterior angles of the parietals, is concave.

The nasal bones are loosely attached. The prefrontals are quadrate in outline, movable, and are between the frontals and maxillaries. The maxillaries occupy a vertical position in front of the orbit and are attached above to the prefrontals and behind to the ectopterygoids. Each possesses a well-developed poisonous fang, and, in its outer surface, a conspicuous and characteristic pit. The parasphenoidal surface is concave and divided by a longitudinal median ridge-like process. Well-developed ventral processes are present on all the vertebræ of the body. The latter never exceed 200, the combined number of body and caudal vertebrae not commonly reaching this number.

Of the family Crotalidae the Ancistrodon shows the least specialization while the highest development is found in the Crotalus. The development of the family is shown in the following ways:

1. By the expansion and flattening of the anterior portion of the skull. This, also, takes place to a less extent in the petrosal region.

2. By the development of the maxillary fang and consequent change in the position and shape of the maxillaries and prefrontals.

3. As specialization proceeds there is a decrease in the number of teeth. Besides the fangs, no teeth are found on the maxillaries, and, except in Ancistrodon, none exist on the pterygoids posterior to their junction with the ectopterygoids.

4. The freedom and mechanical arrangement of the nasals, prefrontals, maxillaries, palatines, pterygoids and ectopterygoids is quite notable.

[2] In this brief article we shall not attempt to refer to the numerous authorities consulted However, it should be stated, perhaps, that the general osteology of the Crotalidae has been worked out and discussed by various naturalists. The results of their works have appeared in many publications and under various dates. Also, we wish to state that Peters, as early as 1862, briefly mentions the craniology of the genus Ancistrodon.

Hr. W. Peters hielt einen Vortrag uber die craniologischen Verschiedenheiten der Grubenottern (Trigonocephali) und uber eine neue Art der Gattung Bothriechis. Monatsberichte der Koniglichen Preufs. Akademie der Wissenschaften zu Berlin, 1862, p. 670.

5. The various vertebral processes increase in length and the ribs of the median portion of the body show a decided tendency to become longer, thus giving the body a spindle-shape.

6. The vertebræ of the body increase in number from Ancistrodon to Crotalus, while the caudal vertebræ show a reverse tendency. In Ancistrodon, the ratio of the body and caudal vertebræ is approximately as 4 to 1, in Sistrurus 5 to 1, and in Crotalus 7 to 1.

Ancistrodon Beauvois, 1799.

Upper surface of the petrosal region convex and not unusually extended to form a support for the squamosals. Post-orbital portion of the parietals without lateral expansions. Pterygoids toothed posterior to their junction with the ectopterygoids. Posterior ends of the ectopterygoids grooved and notched and placed in a socket formed in the upper surface of the pterygoids. Palatines either triangular or club-shaped; in the latter case, attached to the pterygoids by their more expanded ends.

Post-frontals rudimentary if present. Posterior caudal vertebræ not cöossified, i. e., end ossicle absent.[3] Number of vertebræ of the body from 140 to 154; tail 40 to 54.

Eastern and southern United States and Mexico.

Ancistrodon piscivorus La Cepede, 1787.

Outer opening of the lachrymal foramen slit-like and on the anterior margin of the prefrontal. Palatines club-shaped and their more expanded ends attached to the pterygoids.

Number of vertebræ of the body from 138 to 145; tail 30 to 48.

Ancistrodon contortrix Linne, 1766.

Outer opening of the lachrymal foramen on the anterior upper surface of the prefrontal and situated just beneath a small pointed process. Palatines small and triangular in outline, with the obtuse angle pointing upwards. According to Peters, *A. contortrix pugnax* possesses a palatine bone equiangular in outline.[4]

Number of vertebræ of the body from 150 to 155; tail 25 to 40.

[3] In the Rattlesnake, some seven or eight posterior caudal vertebræ coossify, in the process of the growth of the animal, and the bone thus formed has been variously named. J. Czermak speaks of these coossified vertebræ as "Endkorper der Wirbelsaule": see Ueber den Schallenzeugenden Apparat von Crotalus zeitschrift fur wiss. Zoologie. Bd., VIII, p. 294, 1857. Hoffman accepts the name given by Czermak: see Dr. H. G. Bronn's Klassen und Ordnungen des Thier reichs. Sechster Band. III, Abtheilung. Reptilien, III, p. 1417, 1890. Garman calls this bone the Shaker: see On the Evolution of the Rattlesnake. Proc, Bos. Soc. Nat. Hist., Vol. XXIV, 1889.

[4] Loc. cit., p. 673.

Systrurus Garman, 1883.

Lateral expansion of the petrosal region slight. Squamosal short and its posterior end widened into a hook-like process for the attachment of the quadrate. Pterygoids not toothed posterior to their junction with the ectopterygoids and their posterior expanded portions more curved than in other genera. The ectopterygoids are grooved for the reception of the pterygoids. However, their posterior ends are not notched, as in Ancistrodon, but are attached to the pterygoids for a much greater length than in either of the remaining genera. The palatines are triangular and attached to the pterygoids at the acute angle, the obtuse angle being nearer the anterior end of the palatines. Postfrontals rudimentary. Posterior caudal vertebræ cöossified, i.e., end-ossicle present.

Number of vertebræ of the body from 130 to 153; caudal vertebræ from 20 to 35.

United States and Mexico.

I omit the specific characters until opportunity is offered for the study of a wider range of specimens.

Crotalus Linne, 1758.

Petrosal region expanded and the outer edge of the petrosal slightly upturned so as to form a support for the squamosal. The parietals possess clearly marked lateral expansions which connect with the anterior ends of the petrosals. Squamosals relatively more curved than in other genera, not hooked, but their posterior ends expanded. Pterygoids not toothed posterior to their junction with the ectopterygoids.[5] Posterior ends of the ectopterygoids grooved but not notched, and the pterygoids not notched for the reception of the ectopterygoids. The palatines are club-shaped and attached to the pterygoids by their more pointed ends. The postfrontals are well-developed, border the orbital surface of the parietals, and connect with the frontals. The posterior caudal vertebræ are coossified, i. e., possess a well-developed end-ossicle.

Number of vertebræ of the body from 165 to 187; tail from 19 to 32.

United States, Mexico and Brazil.

Explanations of Plates.

Fig. 1.—Squamosal of *A. piscivorus*.

Fig. 2.—Squamosal of *A. contortrix*.

Fig. 3.—Squamosal of *S. catenatus*.

[5] If Dumeril's plates be correct, *C. durissus* does not agree in this respect: see Prodrome de Classification des Ophidiens, 1852. Planche 2, Figs. 14 and 15.

Fig. 4.—Squamosal of *C. confluentus.*
Fig. 5.—Squamosal of *C. horridus.*
Fig. 6.—*A. piscivorus.* a, Pterygoid; b, Ectopterygoid; c, Palatine.
Fig. 7.—*A. contortrix.*
Fig. 8.—*S. catenatus.*
Fig. 9.—*C. confluentus.*

—W. Edgar Taylor.
Acting Professor of Biology, Monmouth College, Monmouth, Illinois.

Zoological News.—Pisces.—The little-known Agonoid Fish, *Hippocephalus japonicus,* is described by F. Cramer. The description is based on an alcoholic specimen presented to the California Academy of Sciences by Dr. Krause, of Berlin. The specimen is 360 mm. long, and was obtained in the Okhotsk Sea. (Proceeds. Cal. Acad. Sci., Ser. 2, Vol. IV, 1894.)

Mammalia.—The Price collection of mammals from southeastern Arizona, and the Granger collection from South Dakota, recently acquired by the American Museum of New York, include a number of new forms, ten of which are described by Dr. J. A. Allen. The collections and the observations of the collectors greatly extend the recorded range of many species of mammals. (Bull. Am. Mus. Nat. Hist., 1894.)

A collection of mammals sent to the American Museum from New Brunswick, numbers about 250 specimens, and contains representatives of several species worthy of note, among which are two specimens of *Synaptomys cooperii* Baird. This is the first record of the genus Synaptomys from New Brunswick. (Bull. Am. Mus. Nat. Hist., 1894.)

In the annotated list of Florida Mammals prepared by Dr. F. M. Chapman, four orders are represented, as follows: Glires, 27; Chiroptera, 10; Insectivora, 4; Carnivora, 12. (Bull. Am. Mus. Nat. Hist., 1894.)

EMBRYOLOGY.[1]

Sexually Produced Organisms without Maternal Characters ?—When it was announced by Boveri[2] than an organism might be formed from a fragment of an egg fertilized by sperm of another species and then possess only the characters of that latter paternal species, this fact naturally gave rise to much speculative application, and was welcomed as evidence of the great value to be set upon the nucleus in the processes of heredity. Boveri stated that bastard larvæ formed by sperm of *Echinus microtuberculatus* and eggs of *Sphaerechinus granularis* were in all respects middle forms between the species. He also stated that when the eggs of the latter species were shaken so that they broke and lost their nuclei and were then fertilized by the sperm of the former, dwarf larvæ were formed that had the characters of the male parent, Echinus, only, and not those of the female parent, Sphærechinus. Thus, he concluded, the male sperm nucleus transmitted paternal characters, while the egg protoplasm, deprived of its nucleus, gave none of the maternal characters to the offspring.

Oswald Seeliger[3] has repeated these experiments with the same species and has shown that Boveri's conclusions are not the necessary ones to be drawn from the evidence, but only interpretations that ignore most weighty factors.

In two plates he gives careful figures of the larvæ of both species at the same stages and also figures of the bastard larvæ. An examination of these convinces one that the normal bastards, or those from whole eggs, are not by any means exactly intermediate between the two parents in all cases. Many do combine the parental characters in this way, but many are much like the father and others more like the mother. This holds both for the general shape and for the structure of the larval skeleton.

Since then, many bastards from whole eggs resemble the father, there is no proof that the bastards from broken eggs were not also from nucleated pieces, for it must be borne in mind, that Boveri failed to get larvæ from isolated fragments, and obtained his dwarf larvæ from the

[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts, reviews and preliminary notes may be sent.

[2] See American Naturalist, March 1, 1893.

[3] Roux Archiv. f. Entwicklungsmechanik. I, 2, Dec. 11, '94.

general mixture of nucleated and non-nucleated fragments that are to be found when the eggs are shaken in a test tube.

Boveri also observed that the dwarf larvæ had small nuclei, coming as he supposed from the male nucleus only, not from two fused nuclei as in ordinary fertilization. This reason is also fallacious since Seeliger finds a great deal of variation in the size of the nuclei in the normal bastards from whole eggs. The small nuclei may come, then, from eggs with nuclei and do not give any evidence as to the absence of a nucleus in the egg fragment.

Again the bastards from the whole eggs vary much in size. In shaken eggs, however, Seeliger finds dwarf larvæ much more numerous than in the case of whole or unshaken eggs.

He concludes that though the fertilization of non-nucleated egg fragments may not be impossible, it is probable that the dwarf larvæ obtained by Boveri were merely the results of fertilization of broken eggs or egg fragments still retaining their nuclei.

Double Monsters.—To the same number of Roux's new periodical, Professor O. Schultze, of Würzburg, contributes some interesting results that he obtained by keeping frog's eggs in a forced position. The eggs of *Rana fusca* were fastened to glass slides and then fertilized and fixed between slides so that they could not revolve when turned upside down.

They were allowed to develop right side up till divided into two cells and then inverted and kept upside down till towards the beginning of gastrulation.

A detailed account of the methods and of the results of individual experiments is given.

It appears that a considerable number of the eggs thus exposed to the disturbing effects of gravitation developed into double monsters of various characters as shown in the two plates. Some developed two heads and two sets of gills on each.

The formation of these double individuals in place of the normal single one, is in some way due to the rearrangement of the substance of the cells when inverted and acted upon by gravity, so that the heavier part is drawn down and the lighter rises, as may be readily seen since it is dark colored. There is thus a modification of the egg substance that acts like a partial division of the egg and allows each of the two cells to develop somewhat as if isolated.

In a discussion of the general question of the formation of double monsters in nature, the author rejects the idea that abnormal or mul-

tiple fertilization is concerned or that subsequent events are the cause. The cause of double monsters lies in some abnormal state of the ovarian egg. This state of the egg may be like that that has in recent experiments produced double formations from half eggs; that is, the abnormality may be its division into more or less separate halves, each of which would form a complete individual if separated from the other.

Double individuals are thus to be regarded as coming from imperfectly divided ovarian cells; eggs similar to the somatic cells that are found with two nuclei. A complete division of the germ material produces separate individuals, a very slight division, double monsters; between these extremes are identical twins.

The formation of double monsters would be, in this speculation, a process of arrested development!

Fusion of Blastomeres.—Dr. Arnold Graf[4] briefly describes a remarkable case of retrogressive cleavage in the eggs of the sea-urchin Arbacia.

Some eggs compressed under a cover-glass after the method of Driesch, divided into flat plates of 16 cells that quickly passed into 32 (here some abnormal conditions may be suspected). When the pressure was removed by adding more water, the cells began to fuse so that their number became reduced to 15 and then 14! At first each has two or three nuclei according as it is made by the fusion of two or of three cells, but later the nuclei fuse and the cells change their positions and shapes. The same phenomenon was seen in a plate of 8 cells.

It is claimed that only those cells unite that are closely related: the daughter cells of one mother cell fuse together.

Unfortunately nothing is known of the possible future of such embryos nor of the effective causes at work in producing them, and so this notice serves more as a stimulus to work than as a contribution to our knowledge of the mechanics of embryology.

Temperature and Development.—Professor O. Schultze[5] finds that the eggs of *Rana fusca* may be kept in water at 0° C for 14 days when in the gastrula stage without losing the power to form normal embryos. During this period there is a complete cessation of development.

[4] Zool. Anz., XVII, Dec., 1894.

[5] Anat. Anz., X, Dec. 19, 1894.

These results are opposed to those of O. Hertwig who found that exposure to 0° C injured the eggs so much that they would not develop.

A Problematical Structure in a Mammal.—Dr. A. W. Weysse[6] in a very careful and well illustrated study of some thirty blastodermic vesicles of the pig, finds a remarkable ectodermic outgrowth arching over the germinal disk. The cavity beneath this "bridge" is never closed, and is eventually obliterated by the fusion of the "bridge" cells with the subjacent ectoderm.

The author thinks this structure has no homology in any thing as yet known among mammals, but may, perhaps, be compared to the dorsal growth in Amphioxus that forms the medullary canal, since they both agree in time of formation and in relations to the neurenteric canal and neuropore!

Development of Scyphomedusæ.—Ida H. Hyde has published the results of a most careful examination of the cleavage, gastrulation and the formation of the scyphistoma stage in several medusæ. The paper is illustrated by more than one hundred very careful and true figures and bids fair to clear up some much disputed points upon which the most noted investigators have held different views.

The material was obtained at Annisquam, Mass., at Eastport, Maine and from Johns Hopkins Marine Station in Jamaica, and was studied at Bryn Mawr, Woods Hole and Heidelberg.

The embryology of *Aurelia marginalis* from Jamaica had never before been studied; that of *A. fluvidula* and *Cyanea arctica* had been, imperfectly.

The gastrulation of *A. marginalis* differs from that of all known Scyphomedusæ in that it is a process of delamination, that is, the blastula becomes converted into a closed two-layered larva by the division of some cells in such a way that their inner ends form an inner layer.

In *A. flavidula* the germ layers are formed in two different ways: eggs from Eastport, Maine, gave rise to the entoderm by a process of delamination combined with inwandering of cells from various parts of the blastula wall; eggs from Annisquam formed invaginate gastrulas.

In *C. artica* the gastrulation is a modified invagination in which some cells break loose from the pole that is invaginating; there is, however,

[6] Proc. Amer. Acad. Arts & Sci., XXX, 1894.

no trace of the multipolar inwandering of cells as described by McMurrich.

In the formation of the Scyphistoma it is found that the planula of *A. marginalis* settles down by the aboral pole which is peculiarly modified.

In all the species examined the mantle is a new formation and not a reopening of a gastrula mouth.

The inrolled part of the ectoderm remains as the œsophagus, and is not invaginated again, so that there is no doubt of the correctness of the views held by Goette regarding the ectodermal nature of this part of the digestive cavity.

The first pair of gastric pouches arises as a pair of outgrowths from the entoderm, but the second pair comes from the ectoderm.

The ectoderm thus takes part in the formation of the œsophagus, the septa and the gastral filaments as well as the second pair of the four original pouches.

Goette's views as to the relation of the Hydromedusæ and Anthozoa are thus strengthened by these observations.

Blastomeres of Medusæ.—Raffaello Zoja, of Pavia, has published a preliminary notice[7] of some most interesting work upon the development of isolated blastomeres of Medusæ and of other non-vertebrates. He finds that even $\frac{1}{16}$ of an egg, that is, one of the isolated cells when the eggs has divided into 16, is able to develop by itself into a perfect organism; it develops in the same way as a complete egg and forms as perfect an individual.

In *Clytia flavidula* $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$ or $\frac{1}{16}$ when isolated develops into a hollow blastula in which entoderm arises by migration. A larva results that differs from the normal whole-egg-larva only in size. In the case of $\frac{1}{2}$ or $\frac{1}{4}$ egg the hydroid form was ultimately obtained. The larva probably has half as many cells as in the normal case.

In *Laodice cruciata* also $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$ or $\frac{1}{16}$ of the egg will grow into a perfect, but small swimming larva.

In *Mitrocoma annæ* $\frac{1}{2}$ or $\frac{1}{4}$ of the egg gives rise to a perfect larva. In *Liriogie micronata* one of the first two or the first four blastomeres may form by delamination a larva with ectoderm and entoderm. In the former case a medusa with the symmetrically arranged tentacles of the adult may result!

The isolated pieces of medusæ eggs develop like the whole egg and not like parts regenerating the rest.

[7] Anatomischer Anzeiger X, Oct., 1894.

Cleavage in the eggs of medusæ thus seems to be a quantitative and not a qualitative process.

Development in Rarified Air.—Professor C. Giacomini[8] has devised an apparatus by which hen's eggs can be subjected to diminished pressure during incubation. The results presented in this preliminary communication are that a pressure of 16 to 17 cm. prevents the normal formation of the vascular organs and incites various monstrosities in the early days of development besides much retarding all the processes of growth.

In later stages embryos are killed by air at that low pressure. These effects seem due to the state of oxygen in the air as they are counteracted by the addition of oxygen to the rarefied air.

The author hopes to have discovered a valuable new aid in the investigation of experimental teratology.

[8] Archiv. Ital. de Biologie, XXII, Dec. 11, 1894.

PSYCHOLOGY.[1]

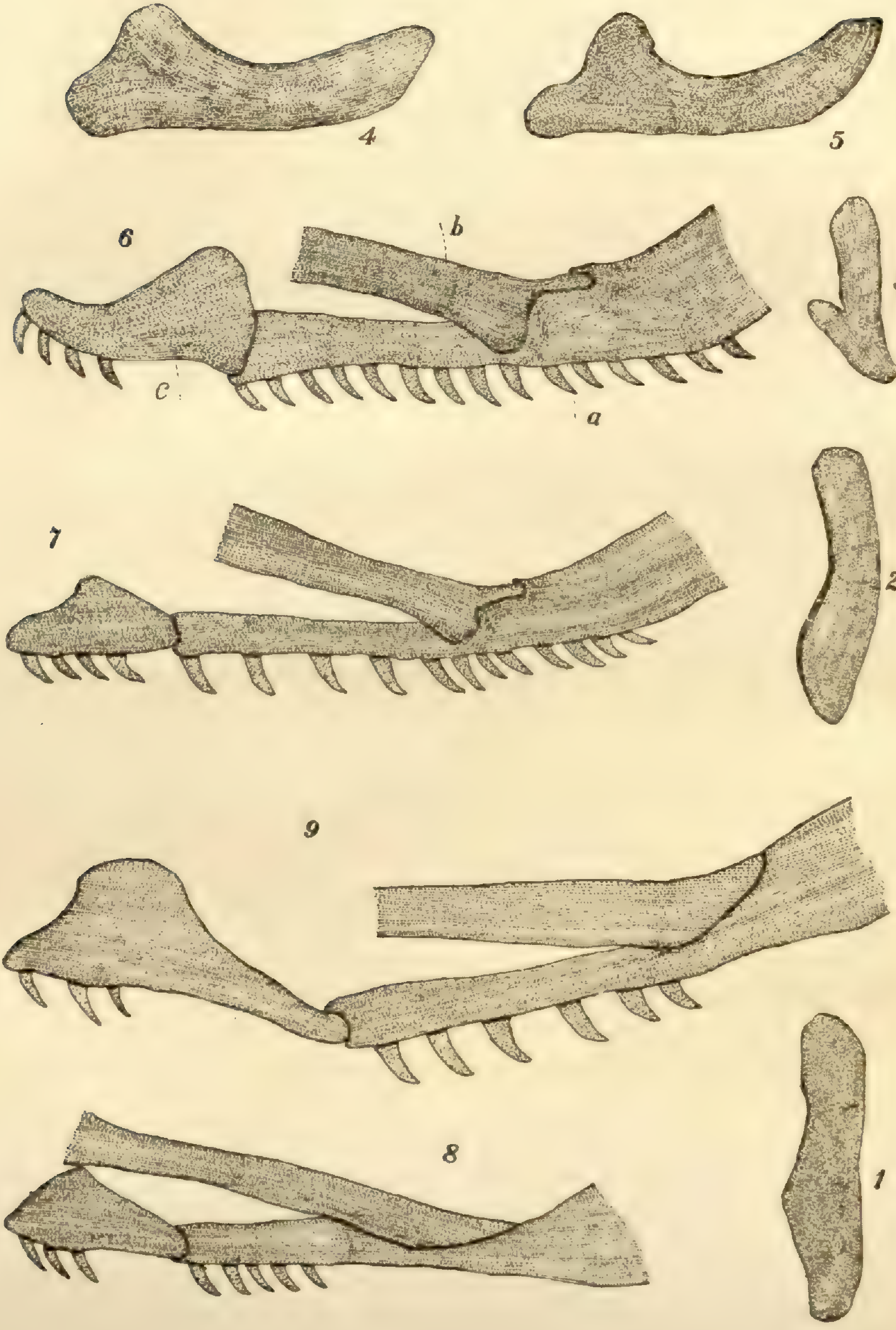
The Present State of Psychology.—At a meeting of the American Psychological Association, held at Princeton during the Christmas holidays just past, Dr. Patton, the eminent President of Princeton University, made an address of welcome to the assembled psychologists in course of which he reminded them that psychology was originally a branch of philosophy as distinguished from science, and urged them never to forget this fact and not to reduce psychology to the level of a mere science.

One, at least, of Dr. Patton's hearers, found his doctrine hard to accept. That psychology has been a part of philosophy all will admit, and, in whatever sense we take that much misused word, it is hard to believe that the time will ever come when the philosophical significance of the facts which it is the province of psychology to observe, and of the laws which she is bringing to light, will be ignored by the thoughtful. There is probably no psychologist so devoted to what Professor James wittily calls "the pendulum and chronoscope philosophy," or so sceptical as to the value of current philosophical theories, as to deny that psychology is to be an important part of the coming philosophy. But this is not, I think, what Dr. Patton had in mind.

For some generations "science" and "philosophy" have been regarded as distinct branches of human activity, and there has been little friendly commerce between their representatives. "Science" is that organized body of knowledge got by observation, experiment and demonstration. The spirit of pure curiosity to which we owe it, is a comparatively new momentum in man's intellectual life. Only in the last three centuries have its greatest discoveries been made. By "philosophy" we commonly understand those ancient disciplines in which the methods of the newer knowledge have been, as yet, but little used. Such are the sciences that deal with the facts of consciousness as such—the "sciences" of Logic, Psychology, Ethics and Metaphysics. These are commonly termed philosophical. Up to very recent times, these branches of learning have been but little affected by the scientific spirit. Their representatives have been, for the most part, men learned in the wisdom of the ancients, but ignorant of that of the moderns, and but little versed in the methods which have been

[1] This department is edited by Dr. Wm. Romaine Newbold, University of Pennsylvania.

PLATE XVIII.



Taylor on Crotalidae.

found necessary to the successful prosecution of research. Many confine themselves to working over and over again all that the thinkers of the past have said, and are ambitious of nothing more. Others, having trained themselves with care in the methods which, after more than two thousand years' trial, have been found wanting, laboriously evolve volume after volume, the contents of which is destined to be forgotten before the printer's ink is dry. Their only instrument is introspection; what the observer sees in his own consciousness he ascribes to his fellow, and if his fellow, using a similar method, maintains the contrary, assuredly, thinks he, his fellow is either a liar or a fool.

Psychology was one of the first of the mental sciences to feel the influence of the new spirit. Descartes and Leibniz, Hobbes, Locke, Hume and Hartley and many others, have faithfully endeavored to record the facts of mental life as they saw them, and to give a satisfactory explanation of them. Nor has their work proved fruitless, although its results are far from satisfactory. In the first place, all used introspection as their chief, or only, method. In the second place, the hypostatizing method of the old Greek psychology still persisted. Instead of recognizing that mental facts, like all facts, must be supposed to conform to laws the discovery of which is the chief end of science, we find a tendency to refer the facts observed to half personified "faculties." In the third place, the kindred science of physiology was, and indeed still is, in an imperfect condition, and it was not possible for the psychologist to bring his results into harmony with it. Until this is done, it is safe to say, the foundations of the science of psychology have not been firmly laid.

Within the last twenty years, psychology has entered upon a new era. Fechner, Weber and Wundt, and a host of followers, have undertaken a thorough examination into the simplest phenomena of mental life, especially into the relation of stimulus to sensation. This school uses, wherever possible, the method of direct experiment, and its ideal is to make psychology a science of determinate quantities. These are the psychophysicists in the narrower sense, and the psychophysical laboratory, with its elaborate apparatus for the regulation of stimulus-intensities and measurement of time-intervals, has come, within the last ten years, to be regarded as a necessary part of every great University. Yet it is openly claimed that the net result to the science of psychology of all this outlay is very small; that the analogy between physical and mental facts and laws has been pressed too far; that the results obtained are, for the most part, of physiological significance only; and, in some quarters the cry is heard, "Back to introspection." But we

must remember that psychophysics is itself in the experimental stage, and, until methods of experiment in these new fields have been devised and perfected, we cannot expect definite results.

There has recently been developed, also within the limits of psychology proper, another discipline known as physiological psychology. It endeavors to determine the physiological conditions of consciousness, and, more particularly, the relation of the different qualities of consciousness to the several cortical areas. Much light has been thrown upon these problems, and, as one chief result, it is possible to introduce into introspection a precision before unknown. The English associationists have taught us, for example, on the basis of purely introspective evidence, that our ideas of physical things are complexes, containing visual, auditory, tactual and other elements—that what we call "knowledge" is a mass of dim, subconscious associations. Researches into the physiology of the brain have shown that color, sound and motion certainly, and probably touch, are related to different cortical areas—that lesions of portions of the cortex will destroy knowledge without impairing sensation. This at once supports the conclusions of introspection and enables us to form more accurate conceptions of the complex processes involved.

In England, the home *par excellence* of introspective psychology, Mr. Francis Galton, in his epoch-making book, "Inquiries into Human Faculty," has called attention to the mental idiosyncrasies of individuals. More recent workers in the same line have shown conclusively that introspection cannot give results that will be, in all cases, true. It is impossible to overestimate the importance of this discovery, and there is nothing more surprising than that a fact at once so important and so easily ascertained, should have escaped notice for more than two thousand years. Since the early days of Greek philosophy, for example, the Nominalists and the Conceptualists have waged unending warfare; the Conceptualists maintain that the name of a class awakens an idea or mental state that is not representative of any member of that class; the Nominalists, on the contrary, hold that the class name either awakens a concrete image of a particular member of the class, or else it awakens no mental state whatever—it is a mere *flatus vocis.* And now we know that both are right. Each was describing what introspection revealed to him, and abusing his fellow-student for doing likewise.

Mr. Galton's discovery of the idiosyncrasies of the individual has not only showed the limitations within which alone introspection can be used, but has served to call attention to other forms of comparative

psychology. Researches into the mental life of children, of the lower animals, of the congenitally blind and deaf, of criminals and the insane, have been eagerly prosecuted. It is not easy to estimate the value of this work to psychology proper. It is difficult to get accurate information as to the mental life of even an intelligent and educated man. When I question him, I can have no security that my question is understood, nor can I know that he attaches to the words of his reply exactly the meaning that I do. In inquiring into forms of consciousness still more widely removed from my own, I encounter greater difficulties. Not only does the danger of misunderstanding language increase, but, in most cases, it is impossible to use language at all, and we are compelled to rely upon analogies based upon movements and expression for our knowledge as to what passes in these lower forms of consciousness. It is not, I think, likely that the science of psychology proper will be much the gainer by this work, except in the case of some special problems. But, on the other hand, it is likely that as our knowledge of human psychology increases, we shall find ourselves more and more able to interpret these divergent forms of consciousness.

There is yet another line of psychological inquiry that has been opened within the last twenty years. This is the study of hypnosis and allied "automatic" states. It has been prosecuted, for the most part, in France, and, as the work has been done rather by physicians than by psychologists, the value of the inquiry to the pure science is, as yet, undetermined. Several attempts have been made, however, to bring these facts to bear upon the general theory of psychology. The most comprehensive and, in my opinion, the most important, is that made by Pierre Janet in his work on "Mental Automatism" ("L'Automatisme Psychologique") published in Paris about five years ago.

Yet another "*Richtung*" is that commonly known as "Psychical Research." Its object is the investigation of phenomena supposed to be "supernatural" or "supernormal." Although not necessarily psychological, it so happens that the great majority of such phenomena have been found to be explicable by simple psychological laws, and it seems, therefore, proper to include it in an enumeration of the chief forms of contemporary psychology. Moreover, many of the phenomena which have not, as yet, been explained by known laws, such as those of telepathy and clairvoyance, would seem to require the assumption of new distinctively psychological principles.

The conception of evolution in psychology, as in all other branches of science, exerts a controlling influence. It is clearly recognized that man's mind, like his body, is what it is by virtue of the environment in

which it exists. The law of preservation has determined the development of the special senses, the emotions, the impulses, and even of the aspects of consciousness which we are accustomed to regard as distinctively human—discursive thought, reasoning and volition. In some cases it is possible to classify mental phenomena teleologically where other bases of classification prove inapplicable, and phenomena formerly unintelligible sometimes become intelligible from this point of view. Yet it must be admitted that genetic psychology is yet to be. The history of some forms of consciousness, it is true, has been fairly well ascertained. We may be said, I think, to know something of the origin of the emotions, of the "recept" and concept, of many impulses and, perhaps, of the simpler types of volition. But no systematic and comprehensive genetic theory has yet been propounded that has met with any considerable acceptance.

It is too late, then, for those who are addicted to philosophy, as distinguished from science, to lament the introduction of scientific methods into psychology. Little by little those methods of exact and painstaking research will make their way into every department of human thought. We are apt to talk much of Logic, Psychology, Ethics and Metaphysics as being the mental "sciences." We forget that, as sciences, they do not yet exist. They exist only as rather ill-coordinated tendencies. Each has a subject matter which is sufficiently well-defined for practical purposes, and each has a few well-worn generalizations that meet with some acceptance. But the very facts with which they deal are still, in large measure, subjects of dispute; the conceptions under which it is proposed to systematize those facts are rough hewn from the vulgar common sense of the community; ill-defined and crude, much labor must be expended upon them before we can hope to make our facts intelligible. This is the work to which the student of mental phenomena must address himself. If we draw a distinction between science and philosophy, even though we cannot, as yet, claim for psychology the proud name of a science, let it be once for all understood that she is to be regarded as a scientific rather than a philosophical discipline.

But why should any such distinction be drawn? The word "philosophy" is, as I have said, frequently applied to those branches of learning which we have inherited from the ancients, which still preserve, on the whole, their ancient form. And the usage is not without justification. For the "philosopher" was originally a man who pursued knowledge for its own sake, and the knowledge which he acquired constituted his philosophy. But this is what we mean to-day by "sci-

ence." Mathematics, physics, astronomy and psychology were all alike parts of the Greek "philosophy," and it is not surprising that we have retained the old name for the older science while we have coined a new word for the newer. In course of time, however, all branches of human knowledge will certainly be brought within the domain of science, and the older word will be free for a new sense. Now there remains a science, as yet undeveloped, for whose designation this term should be reserved. When the other sciences have been brought to higher perfection, and we have obtained a more exact conception of the cosmos, we shall desire to understand that cosmos in its relations to the human being as such. This science, to which all other sciences will contribute, which will formulate the laws under which the human consciousness stands in its relation to the totality of existence and deduce therefrom the principles by which the life of the individual is to be guided, may justly be termed by that ancient and revered name, Philosophy,—The Science.—W. ROMAINE NEWBOLD.

ARCHEOLOGY AND ETHNOLOGY.[1]

The Contention of Mr. J. D. McGuire that stone polishing must be and is as old as stone chipping, and that we have no evidence of a time when man did not know how to polish stone and make pottery, induced me when in Europe last summer (1894) to ask several explorers of caves and drift beds in Italy, England and Germany, whether, like Mr. McGuire, they had come to suspect the presence of pottery or polished stone in these oldest human culture layers.

Professor Dr. Johannes Ranke, of Munich, has been kind enough to send me the following very interesting series of notes upon the subject, and I hereby print them subjoined to my questions (in italics) as originally propounded to him.—H. C. MERCER.

The Results of Cave Exploration in Germany.—I. *Have you found proof in German (Austria-Hungary, etc.) caves, of a time when man was in a Paleolithic state—chipped but could not polish stone—and make pottery?*

Ans. My observations and investigations of prehistoric man are given in full in my book "Der Mensch," Vol. II, (II edition, 1894, Leipzig. Sibleoz Institute), where answers to all your questions may be found.

Further, I would say, that the objects found in one layer of a cave are only in very rare cases proved to be contemporaneous, for example, the case of the celebrated excavations of Dr. Nüesch, Schaffhausen, Switzerland, in "Schweizerbild," (1. Der Mensch, II, p. 454); in other caves many objects of different epochs, some even modern, are found in the same layer. It is on these grounds that I can give no complete proof regarding the *cave finds* in the district referred to by you, Austria-Hungary, Germany, Switzerland.

On the contrary, we have in Germany, Austria-Hungary, places of discovery, not properly caves, in undisturbed diluvial layers, in which objects found in one layer are entirely proved to be of contemporary date. The place of discovery near Schaffhausen is not a veritable cave, but a shelter under over-hanging rocks, where a layer has been found, layer No. 4, with many remains of the reindeer period, cave bear, diluvial horse, etc. No polished, but only chipped stone; no pottery, no dog. The place of discovery by Saubach offered undisturbed

[1] This department is edited by H. C. Mercer, University of Pennsylvania.

diluvial layers with bones of mammoths, rhinoceros, cave lion, and cave tiger, only chipped; no polished stone implements, no pottery, no dog.

The best examined diluvial places of discovery (reindeer period) in Germany, on the Schasten Quelle, gives only chipped, no polished stone implements, no pottery, no dog.

In the celebrated caves, Ofnet, Hohlefels, Raubershohle, in the layer of discovery of the diluvial man, chipped stone implements were found with pottery, but the pottery is much later and belongs mostly to the Hallstate period. From the Kesslerloch I have myself found a fragment of pottery, but it is much more recent. Where fragments of pottery have been found in Germany together with remains of diluvial man, the fragments of pottery are, in my opinion, decidedly much later. All clean places of discovery in undisturbed diluvial layers yield no pottery. Fragments of pottery are wanting also in the station lately so much talked of, containing mammoth, etc., in Piedmont (v. my book, II, p. 493).

II. *Has pottery been found in layers with mammoth, rhinoceros and cave bear, etc., in German caves?*

As above mentioned mammoth, rhinoceros, cave bear, have been found with pottery in the same layer, but not contemporaneously, the potsherds are undoubtedly of much more recent date. The layers in question were not undisturbed; in the undisturbed layers at Schaffhausen, no fragments of pottery are found.

III. *Has polished stone been found in similar layers?*

Where polished stone implements have been found in the same layer with diluvial remains, the layer has not been undisturbed. Fragments of pottery and other things were found of the Neolithic period or a still later period. In undisturbed diluvial layers, in our investigated districts, neither polished stone implements nor fragments of pottery have been found.

IV. *Is there any evidence in German caves or gravel beds to prove or disprove subdivisions of the oldest stone period (Paleolithic) into river drift, Mousterien, Solutrien and Magdalenien (of Mortillet)?*

For this kind of discovery we are without the necessary ground. The richest discoveries made up to this time, at least in Germany, have been of the Reindeer period.

V. *From excavation of German caves do you think that where very prominent and conspicuous, they contain in layers one above another, traces of all savage people who have inhabited the region, i. e., that they*

were places of temporary resort used at all times in man's history, or that they were only at one age, the fixed habitations of a race of Cave Men?

Our caves in Germany point out in their contents a now almost uninterrupted chain of discoveries from the diluvial period, through all the centuries to modern times. Besides bones of diluvial animals, I have found in the same layer pieces of or example of a cooking-pot, also fragments of the Hallstate period. An exact division of layers is almost impossible to accomplish. An exception is offered in the above referred to station of Dr. Nüesch in Schaffhausen (v. my book) where the different layers are distinctly divided. There one finds layers of the different periods one above the other, of all peoples who lived in that region. The caves are like towns, periodical refuges, which were used in all ages of man, and still are to-day.

In the cave region of the Franconian Jura, in Bavaria, in the so-called Franconian Switzerland, where you have already excavated yourself, a people in the Neolithic period have been proved to have lived in many grottoes and caves. Our Neolithic people were also cave dwellers there, as well as the diluvial man who lived there, whose traces, mixed with more recent, have been proved to lie there. "Cave Men" were also there before our Neoliths (v. my book, p. 545).

VI. *Have you noticed any lines of direction of migration in the cave evidence for all Europe? Do the layers get thicker and the remains older as you advance geographically in any given direction, so as to indicate that man of that time came to or from any direction?*

I have been unable to find any traces of the wandering of diluvial man (v. in my book in map of diluvial discoveries on page 418).

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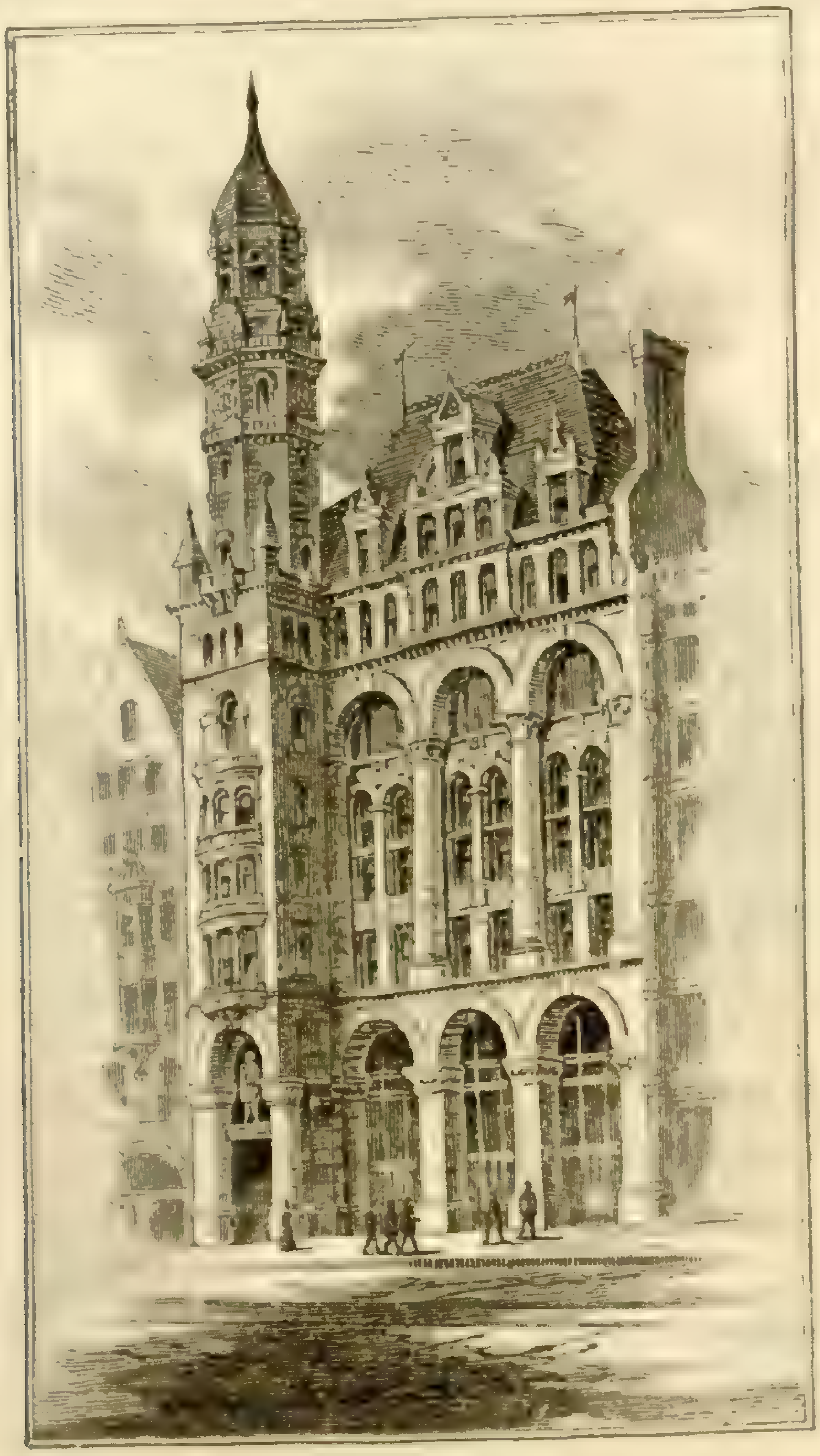

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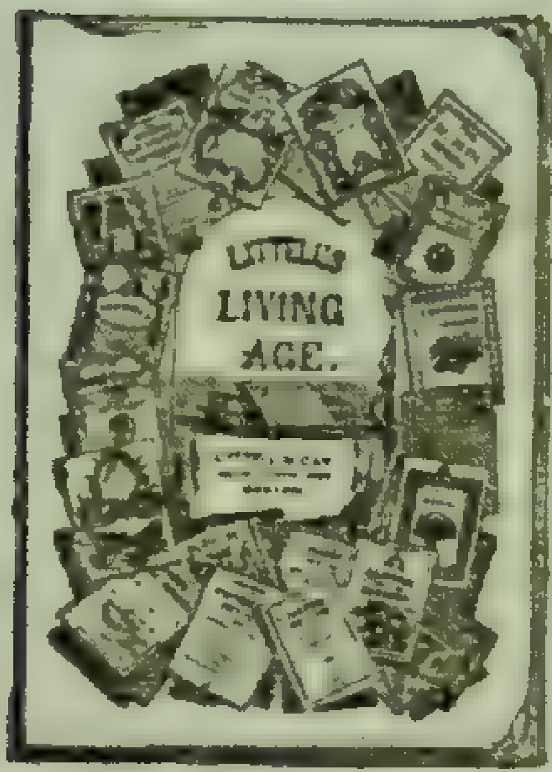

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Vol. XXIX. APRIL, 1895. No. 340

CONTENTS.

PAGE.

ON THE PRESENCE OF FLUORINE AS A TEST FOR THE FOSSILIZATION OF ANIMAL BONES. *Thomas Wilson.* 301

EXPERIMENTAL EVOLUTION AMONGST PLANTS. *L. H. Bailey.* 318

OBSERVATIONS ON A SO-CALLED PETRIFIED MAN. *J. M. Stedman.* 326

ON THE VALIDITY OF THE GENUS MARGARITANA. *Chas. T. Simpson.* 336

EDITOR'S TABLE.—Modern Systematic Writers.—The Endowment of Original Research—Antarctic Exploration.—Wood's Holl; a Correction.—The Philadelphia Academy and Lieut. Peary. 345

RECENT LITERATURE—Botany in the Secondary Schools—The New Check-List of Plants—Bulletin of the U. S. Fish Commission Vol. XII—Paleontology of Missouri, Part I. . . 348

RECENT BOOKS AND PAMPHLETS. 353

GENERAL NOTES.

Geography and Travels.—Where is the greatest forest in the World? 356

Mineralogy—Symmetry of Nepheline and Davyne—The Minerals of the Emery Deposits of Naxos—Boleite and Cumengeite—The Formula of Pseudobrookite—Formula of Staurolite. 358

Petrography—Some Basalts of Asia Minor—The Igneous Rocks of the Eureka District—Notes from Minnesota—The Geology of Dartmoor, England—Miscellaneous Notes. . . . 362

Geology and Paleontology—Origin of the Continental Area of Australia—The Carboniferous System of Brazil—The Affinities of Agriochaerus—The Mastodons of Russia—Geological News, Paleozoic—Mesozoic. 366

Botany—Nitrogen Fixation in Algæ—Rules for Citation. 371

Zoology—The Senses of Pilumnus—More Deep Sea Fishes. (Illustrated.)—Destruction of Food Fishes—A Swallow Roost at Waterville, Maine—The Distribution of Seeds by Birds—The Effects of Cold—Zoological News. . . 376

Entomology—Two more new species of Lecanium—A new Trombidian. (Illustrated.) . 381

Embryology—Cytotropism. 385

Psychology.—Lloyd Morgan's Introduction to Comparative Psychology. 388

Archeology and Ethnology—The Antiquity of Man at Petit Anse (Avery's Island), Louisiana—Notes on a Collection of Archeological and Geological Specimens Collected in a Trip to Avery's Island (Petit Anse), Feb. 1st, 1890. . 393

Microscopy—Preservation of some Marine Animals. 399

PROCEEDINGS OF SCIENTIFIC SOCIETIES. 402

SCIENTIFIC NEWS. 404

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ON THE PRESENCE OF FLUORINE AS A TEST FOR THE FOSSILIZATION OF ANIMAL BONES.

BY DR. THOMAS WILSON.

The discovery of the existence of fluorine in animal bones was made by Morichini in the early years of the nineteenth century, and was soon thereafter confirmed by the leading chemists, although there were considerable discussions and some disputes in regard to its presence. Berzelius in his *Traitè de chimie,* Vol. VII, page 473, 1833, reports having certainly found it in animal bones, but says it was less than two per cent. About the same time, Gay Lussac, in his lectures before the Faculty of Science, says that the fluoride of calcium exists in the proportion of about one one-hundredth in the composition of bone and the enamel of teeth. On the contrary, in 1843, Girardin and Priesser, in their *Memoire sur les os anciens et fossiles,* in the *Annales de physique et de chimie,* 1843, Vol. III, page 370, declare that they have not been able to find the least trace of fluoride of calcium in ancient human bones, and that the existence of this salt in recent animal bones is more than doubtful. But this difference was all put to rest and beyond doubt by the investigations of Mons. Fremy in his *Recherches chimiques sur les os, Annales de physique et de chimie,* 1855, Vol. I, page 47. But it was, as they

say, in a quantity so small that the most delicate mechanism and operation were required to find it, and emphasizing this on page 70, he declines to give any analytic method by which he can determine the exact quantity of this salt in the bones tested. The results of analyses of Von Bibra were to the same effect. Heintz believes that he had found in the ash of the human femur from three to five per cent of the fluoride of calcium; while Zaleski made it less than one per cent.

The discoveries of prehistoric man in later times has rendered this investigation of greater interest than ever before. No prehistoric anthropologist of serious application, but has greatly desired some test which might even, in a measure, determine the relative, if not the actual, antiquity of bones found in prehistoric graves. To these persons it will be welcome news that the discoveries of the existence of fluorine in different proportions in recent bones and those of antiquity will furnish a test of their respective ages, however slight and uncertain it may be. It may be only partial, cannot be depended upon in all cases, but will be, nevertheless, a source of gratification if it be a step towards the solution of a controverted point. It may be freely conceded that animal bones deposited in one locality may possess a greater quantity of flourine than they would have if deposited in another. The condition of their surroundings, the presence and association of different salts may produce a decided effect upon the results. But there may be cases in which these differences do not exist, and hence, this test may be invoked with considerable benefit. A deposit of human and animal bones may be mingled together, the fossilization of the latter may be determined from other knowledge of their antiquity, while the deposit, being in the same locality, subjected to the same conditions, having the presence of the same chemical constituents, the difference in fluorine of the various bones may afford in some degree, possibly slight, a test as to the antiquity of human bones. Such a test and comparison was sought to be made by the writer in the case of the deposit of animal bones found at Natchez by Dr. Dickeson. Along with them was a fragment of a human pelvis. While they were not actually touching

each other, they were practically so—they were in the same position, same deposit, and, so far as is possible to determine, subject to the same chemical influences: therefore, a comparison between the two ought to give an idea of their comparative ages.

These bones are shown in one of the alcoves of the Museum of the Academy of Natural Sciences, Philadelphia. They are fossil bones of extinct animals of the plistocene period. In color, texture and general outward appearance they have a remarkable similarity as though they belonged together. They are well preserved, firm in texture, and of a dark chocolate-brown color which has been attributed to ferruginous infiltration. They consist of a nearly entire skull of *Megalonyx jeffersonii*, teeth of the *Megalonyx dissimilis* and the *Ereptodon priscus*, bones of the *Mylodon harlanii*, bones and teeth of the *Mastodon americanus*, and teeth of *Equus major* and *Bison latifrons*. Along with them is the os innominatum of a human subject. The question affecting the antiquity of man is whether these subjects, the bones of which were found together, were, when alive, contemporaneous, and whether the evidence of age in one is evidence of age in the other. They were, all presented to the Academy by Dr. Dickeson at the meeting in October, 1846; description thereof is to be found in the Proceedings of the Society for that year, vol. iii, p. 106. Dr. Dickeson reported at that time that they were discovered by him in a single deposit at the foot of the bluff in the vicinity of Natchez, Mississippi. He says, "The stratum that contained these organic remains is a tenacious blue clay that underlies the diluvial drift east of Natchez, and which diluvial deposit abounds in bones and teeth of the *Mastodon giganteum;* that they could not have drifted into the position in which they were found is manifest from several facts, first that the plateau of blue clay is not appreciably acted on by those causes that produce ravines in the superincumbent diluvium; second, that the human bone was found at least two feet below the three associated skeletons of the *Megalonyx*, all of which, judging from the position or proximity of their several parts, had been quietly deposited in this locality, inde-

pendent of any active current or other displacing powers; and lastly, because there is no mixture of diluvial drift with the blue clay, which latter retains its homogenous character equally in the higher parts which furnished the extinct quadrupeds and in its lower part which contained the remains of man." These specimens thus found associated were made the subject of investigation by Sir Charles Lyell, and afterwards by Dr. Joseph Leidy, the latter having published a memoir with illustrations of the human bone in the Transactions of the Wagner Free Institute of Science, vol. ii, p. 9. He says, "It differs in no respects from an ordinary average specimen of the corresponding recent bone of man."

Dr. Leidy says Lyell expressed the opinion that, although the human bones may have been contemporaneous with those of the extinct animals with which it has been found, he thought it more probable that it had fallen from one of the Indian graves and had become mingled with the older fossils which were dislodged from the deeper part of the cliff, and Dr. Leidy adds: "In the wear of the cliff the upper portion, with the Indian graves and human bones, would be likely to fall first, and the deeper portions with the older fossils, subsequently on the latter."

Although Dr. Leidy testifies to the general similarity of appearance of the human with the other bones, it does not seem to have occurred to him to have them analyzed and compared. Remembering the story told by the analysis and consequent comparison of the Calaveras skull with that of the rhinoceros teeth found in a formation corresponding in age, though in a different locality; and of the fact apparent therefrom that the Calaveras skull was in an equally advanced stage of fossilization as the rhinoceros teeth, I deemed it wise to make an examination and test by analysis. To this end I applied to Prof. Angelo Heilprin, and through him to the authorities of the Philadelphia Academy of Natural Sciences, so a few months since specimens certified by Prof. Heilprin have been taken, one from the bone of the man and the other from one of the bones of the mylodon, choosing those which, for size, texture and general appearance, bore the greatest likeness one

to the other. These were submitted by me to Mr. Hildebrand, a Chemist of the United States Geological Survey, on duty at the National Museum, who furnishes the following result of his analysis.

TWO FOSSIL BONES.

		Man. Per cent.	*Mylodon.* Per cent.
Loss at 100°C.		4.55	6.77
Loss on ignition		16.54	21.18
Silica	($Si\,O_2$)	22.59	3.71
Phosphoric acid	($P_2\,O_5$)	17.39	23.24
Alumina	($Al_2\,O_3$)	3.21	4.02
Iron protoxide	($Fe\,O$)	5.65	4.44
Manganese protoxide	($Mn\,O$)	1.65	3.40
Lime	($Ca\,O$)	25.88	30.48
Magnesia	($Mg\,O$)	0.95	0.78
		98.41	97.02

"Alkalies, carbonic acid and fluorine were not looked for, owing to the small amount of available material, hence the low summation."

The failure to test for fluorine is much to be regretted, and was the cause of a second application for a greater quantity with which to make another analysis. It will be reported further on in this paper.

The importance of this analysis will be apparent at a glance. The human bone is in a higher state of fossilization than is that of the Mylodon. It has less lime and more silica. In their other chemical constituents they are without any great difference. Of lime the bone of the Mylodon has 30.48%, while that of man has but 25.88%. Of silica the Mylodon has 3.71%, while man has 22.59%. I am well aware of the ordinary uncertainty of this test when applied to specimens from different localities and subjected to different conditions; but in the present case no such differences exist. The bones were all encased in the same stratum of blue clay, and were subjected

practically to the same conditions and surroundings. As one swallow does not make a summer so the discovery of one specimen does not prove the antiquity of man; but it is to be remarked that upon each discovery and in almost every investigation the evidence found points towards higher antiquity of man and tends to show the occupation of the earth by prehistoric man to be more and more extensive. This discovery is simply a fact to be put down to the credit of the high antiquity of man. We should proceed in the same direction to discover other evidences, to investigate the value of those already found; and as they accumulate, each one, or all together, should be given their fair value, in the endeavor to arrive at a truthful conclusion, independent of *a priori* theory or preconceived idea.

The possibility of the determination of the relative antiquity of human bones found in prehistoric graves has set the chemists and prehistoric anthropolgists to an investigation of the fluorine test. Mons. Zaborowski presented a paper before the Academy of Sciences at Paris on the 1st of May, 1893, upon the differences in the chemical composition between two skeletons alleged to be prehistoric, those of Thiail and of Villejuif. These analyses were made by Mons. Adolphe Carnot, Engineer-in-Chief of Mines, and a professor of the Superior School of Mines, Paris. The result of these analyses was to show that the skeleton of Villejuif was much the oldest of the two and that it accorded well with other ancient bones which, from their surroundings and associations, were definitely determined. In the Bulletins de la Societe d'Anthropologie of Paris, Vol. IV, No. 6, the Seance of 18th of May, page 309, Mons. Emile Riviére gave the results of his investigations, comparisons and analyzations of alleged prehistoric bones belonging to the deposit of Billancourt. The excavations of this deposit have been pursued by Mons. Riviére during the seven years from 1875 to 1882, and the extinct fauna which he had obtained therefrom consisted of *Elephas primigenius, Rhinoceros tichorinus, Cervus megaceros, Tarandus rangifer, Bos primigenius*, etc. There were also found in one of the river drifts in the immediate neighborhood of Billancourt, the re-

mains or fragments of two human skeletons. These human bones were transmitted to the museum with the suggestion that they belong to the same epoch and, consequently, were of the same antiquity as the deposit of Billancourt, although MM. Rivière and Gaudry, judging from the aspect, texture, density and, in fact, in all their physical characters, were of a contrary opinion. This last proposition was combatted by several members of the Congress, and it was insisted that the human bones were contemporaneous with the ancient animal bones. These bones were afterwards, and for the purpose of settling or aiding at least in settling the disputed question, submitted to Mons. Carnot, who reported in his analysis that fluorine in the human tibia was but $\frac{17}{100}$ of one per cent, while in the animal bones it was found in quantities of one per cent and $\frac{43}{100}$. Mons. Carnot reports that, taking the average of the specimens, the presence of fluorine in the animal was from seven to nine times greater than that in the human skeleton, and that the human skeleton contains nothing or but slightly more than was to be found in modern bones; and his conclusion was that the human bones were much more recent. Mons. Carnot has given the results of his investigation, the manner of the conduct of his experiments, his method of analysis, and his opinion of the whole matter in a recent paper in the *Annales des Mines*, 2nd Bulletin of 1890, page 155.

The remainder of this paper is, for the most part, a translation of that of Mons. Carnot which, made by the present writer, has very kindly been revised for correction of chemical terms and formulæ by Prof. R. L. Packard.

Process of Analysis pursued and recommended by M. Carnot.—Bones are composed partly of mineral and partly of organic matter. We are to deal only with the mineral, but must first determine the amount or proportion of the organic matter, and to this end the specimen to be operated upon is calcined at a moderate temperature, in such way as to preserve only the ashes or burnt bones. The caustic lime produced by calcination is converted into carbonate of lime by the addition of carbonate of ammonia, evaporation and calcination near 200 degrees before weighing the ashes. By taking the weight of

fragments of bone well washed and dried, then the weight of the ashes, the difference may be considered as representing the the weight of organic matter.

The ash of modern bones is formed of the following elements: tribasic phosphate of lime in the largest proportion, with a small quantity of phosphate of magnesia, very little fluoride and chloride of calcium, carbonate of lime, very little peroxide of iron and of aluminum and, finally, an extremely small proportion of alkaline salts, as chlorides, sulphates and, possibly phosphates.

In the fossil bones we will see that the proportions of phosphate and of carbonate of lime vary, that those of magnesia and of chlorine change very slightly, while the fluoride of calcium is in a greater and more important quantity. There is often much more oxide of iron and sometimes phosphate of iron, sometimes crystallized silica, frequently a little sand or clay, and finally, in certain cases, sulphate of lime and pyrites.

Complete Analysis.—This operation, performed upon modern bones, comprises the following:

1.—Determination of fluorine.
2.—Determination of chlorine.
3.—Determination of carbonic acid.
4.—Determination of phosphoric acid and the bases (lime, magnesia, alumina, and oxide of iron).

1. *Fluorine.*—The determination of fluorine is performed in the method described in detail in the *Annales des Mines*, 1st number; 1893, page 130; the general features of which, however, are as follows: The decomposition of the fluoride in presence of a great excess of silica by concentrated sulphuric acid, in an apparatus entirely dry, with a slow current of dry gas running through it; the transformation of gaseous fluoride of silicon into fluosilicate of potassium, which is collected, washed, dried and weighed. If the chlorine is in a quantity not to be neglected, it is absorbed by passing the current of gas through pumice impregnated with sulphate of copper and heated until the dehydration is complete. The same reagent

will arrest sulphuretted hydrogen when the calcined matter contains a sulphide which is decomposed by sulphuric acid. If there be organic matter which can evolve sulphurous acid, the latter can be retained by the use of caustic lime freshly calcined. In the case of substances containing iodine, it is moved by means of the copper turnings placed before the sulphate of copper. In determining fluorine, 5 grams of the ash of modern bones to 2 grams of fossil bones are employed in such way as to always have a convenient quantity of fluosilicate of potassium to determine on the balance.

2. *Chlorine.*—For the determination of chlorine a special operation is performed, treating one or two grams of ash by cold nitric acid slightly diluted. When the solution is complete, we add water and nitrate of silver. The weight of chloride of silver dried, will give the proportion of chlorine.

3. *Carbonic Acid.*—The proportion of carbonic acid enabling us to calculate the carbonate of lime is obtained by attacking from two to four grams of ash by nitric acid in a small flask exactly weighed and provided with a tube containing pumice saturated with sulphuric acid (*paunce*) to retain humidity. At the end of the operation, the carbonic acid is replaced by dry air by aspiration, and the apparatus is weighed. The loss of weight represents the carbonic acid disengaged.

4. *Phosphoric Acid, Lime, Magnesia, Alumina, and Oxide of Iron.*—Two grams of ash are used in this operation. Dissolve in hydrochloric acid and heat in a capsule of platinum a sufficient length of time to drive out the fluorine. The solution diluted with water, is then filtered, afterwards saturated by ammonia until the commencement of precipitation of phosphate of lime, then redissolved by acetic acid added little by little in slight excess in such a manner as not to produce a noticeable heating of the liquid.

Phosphate of iron is precipitated in this way alone or with phosphate of aluminum. If this precipitate is almost insignificant, we take the weight after washing and ignition and according as (1) the absence or (2) the presence of aluminum is observed, we calculate by the following formula the weight

of the different elements (without separating the iron and aluminum):

$$(1.)\ P_2O_5Fe_2O_3=p,\quad P_2O_5=0{,}47p,\quad Fe_2O_3=0{,}53p.$$
$$(2.)\ P_2O_5\left({}^{Fe_2O_3}_{Al_2O_3}\right)=p',\ P_2O_5=0,\ 50p',\left({}^{Fe_2O_3}_{Al_2O_3}\right)=0{,}50p'.$$

If the precipitation is somewhat voluminous, the elements are determined by separating the phosphoric acid by molybdate of ammonia. The acetic liquid, from which phosphate of iron and aluminum has been removed, is diluted to 200 cubic centimetres. Exactly the half is then taken to determine the lime, the magnesia and the phosphoric acid; the other half is put in reserve to verify the result in case of need. The addition of oxalate of ammonia, neutral and pure, will determine the precipitation of lime, which is separated as oxalate and is determined as caustic lime, carbonate or sulphate of lime. The filtered liquid, supersaturated with ammonia, is left in repose during 24 hours and gives a precipitate of ammoniomagnesium phosphate, of which the weight, after ignition, enables us to calculate the magnesia and a part of the phosphoric acid.

$$P_2O_52MgO=p_1,\quad 2MgO=0{,}36p_1,\quad P_2O_5=0{,}64p_1$$

The rest of the phosphoric acid is precipitated in the final solution by the magnesia mixture, and is determined as P_2O_52MgO.

Rapid Methods.—In the large series of modern and fossil bones which have been examined, it would have taken a long time and been, perhaps, without benefit to make the complete analysis. In most cases it is sufficient to make, along with the qualitative analysis, the exact determination of fluorine as fluosilicate of potassium and the rapid determination of phosphoric acid by means of a standard solution of uranium. This operation is executed in the following manner: 2 grams of the ash are dissolved in hydrochloric acid, and the liquid is neutralized and the phosphate of iron or iron and aluminum separated as before described, of which we take 47 or 50 per cent. to represent the weight of the phosphoric acid. Almost

all the phosphoric acid is found in the acetic solution with which we proceed to a volumetric test. It is unadvisable to pour into the acetic solution the standard solution of uranium, because the latter will cause some phosphate of lime to precipitate with the phosphate of uranium and we should, in consequence, find too small a proportion by measuring the volume of uranium solution employed.

We arrive at a more exact result by making the determination by the indirect method: We dilute the liquid to 200 cubic centimetres, then pour it, with the aid of a graduated burette, into a measured volume of a standard solution of nitrate of uranium, to which is added a little acetate of soda slightly acidified by acetic acid and the solution is heated to near 80 degrees. We stop when one drop of the liquid, placed on a porcelain saucer, in contact with a little ferrocyanide of potassium in powder, will cease to give a brown color. In order to standardize the solution of uranium, we operate in the same manner, starting with an exactly known weight of phosphate of lime. By taking phosphate of lime exactly analyzed, we succeed better than by taking pure phosphate of soda, because we standardize and make the determination in conditions which are identical. We add pure water to such extent that 40 cubic centimetres correspond exactly to O.200gr. of phosphoric acid (or 1 cubic centimetre to O,005gr. of P_2O_5). The operation should be performed a second time for verification. In the assay of a phosphate, if one operates on 2 grams and makes the acetic solution up to 200 cubic centimetres, we can calculate the proportion of phosphoric acid from the volume V of the liquid which will have saturated the 40 cubic centimetres of the solution of uranium. The volume contained O.200gr. of phosphoric acid. As a consequence, in 1 gram of phosphate, or 100 cubic centimetres of the liquid, there would be Ogr, $200 \times \frac{100}{V}$ (V being expressed in cubic centimetres).

The following table gives the results of analyses for a certain number of bones of varied origin.

These analyses confirm at nearly all points the conclusions that M. Fremy has drawn from his numerous analyses. We remark with him as to the constancy in the proportions of

phosphate and carbonate of lime in genuine bones, whether we compare the different parts of the same bone, the different

	Human—Body of Femur.	Human—Head of Femur.	Ox, Tibia.	Manatee rib—Modern.	Elephant Femur—Modern (Siam).	Elephant tooth, Dentine.	Elephant tusk, Ivory.	Bones of Grand Serpent.	Trionyx Shell.	Testudo radiata.	Crocodile.	Varan a deux Bandes (Monitor).
	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.
$P_2O^5 3CaO$	87,45	87,87	85,72	81,82	90,03	86,87	82,08	89,80	80,37	81,87	87,67	87,32
$P_2O^5 3MgO$	1,57	1,75	1,53	2,62	1,96	3,82	15,72	1,91	1,46	1,49	1,05	1,69
$CaFl_2$	0,35	0,37	0,45	0,63	0,47	0,43	0,20	0,43	0,27	0,35	0,33	0,57
$CaCl_2$	0,23	0,30	0,30	0,36	0,20	0,20	traces	0,20	0,10	0,16	0,34	0,24
$CaOCO^2$	10,18	9,23	11,96	14,25	7,27	7,27	2,04	7,41	16,58	15,80	10,69	9,88
Fe^2O^3	0,10	0,13	0,13	0,15	0,15	0,15	0,08	0,15	1,09	0,13	0,17	0,12
	99.98	99,65	100,09	99,83	100,08	100,11	100,12	99,90	99,87	99,80	100,25	99,82

bones of the same individual, or the bones of animals of different species. The same observation can be made for the proportion of fluoride of calcium which appears always to fall within the limit from $\frac{1}{3}$ to $\frac{1}{2}$ per cent. Chloride of calcium is almost always in less quantity than fluoride; it is the same with the oxide of iron except in the shell of the turtle trionyx (IX). It is necessary, nevertheless, to notice some exception in this constancy of proportion in bony substances of special nature, like the teeth or tusk of the elephant and the shell of the turtle. The phosphate of magnesia, almost always less than 2 per cent, is raised to near 4 per cent in the tooth of the elephant (VI) and passes 15 per cent in the tusk of the elephant (VII) of which it contributes, possibly, to augment the compactness and resistance. At the same time the carbonate of lime which often forms more than 9 per cent of the substance of bone, drops to 2 per cent in the ivory. The carbonate of lime is sensibly in superior proportion in the average of bones of herbivorous animals, and above all, in those that live in water, the manatee and the turtle (IV, IX, X).

The principal object of this paper has been to compare modern bones with fossil bones of similar species in order to discover the relative amount of fluorine and phosphoric acid, and to that end numerous analyses have been made, the results of which can better be given in the form of a table.

The first column of figures gives the proportion of phosphoric acid, the second the proportion of fluorine, the third gives the calculated *ratio* of this proportion of fluorine to that of an apatite having an equal amount of phosphoric acid.

Bones of Modern Animals.	Phosphoric Acid.	Fluorine.	Proportion calculated for apatite.
Human Femur—Body	40,91	0,17	0,05
Human Femur—Head	41,20	0,18	0,05
Human rib	36,80	0,22	0,06
Bone of Ox	40,10	0,25	0,07
Bone of Calf	40,32	0,23	0,06
Bone of Elephant	41,24	0,23	0,06
Tooth of Elephant—Dentine	41,77	0,21	0,05
Modern Ivory	46,12	0,10	0,02
Bone of Manatee	38,93	0,31	0,09
Bone of Dugong	38,03	0,27	0,08
Bone of Rytina gigas	39,52	0,24	0,07
Bone of White Swan	38,20	0,19	0,05
Shell of the Trionyx	37,54	0,13	0,04
Bone of Testudo radiata	38,30	0,17	0,05
Bone of large Serpent	42,16	0,21	0,05
Bone of Crocodile	40,88	0,16	0,04
Bone of Varanus	40,91	0,28	0,07
Bone and Spine of Turbot	40,96	0,11	0,05
Bone and Spine of Codfish	41,27	0,24	0,06
Bone and Spine of Pike	38,26	0,16	0,05

It can be seen from this table that the amount or quantity of Fluorine in these modern bones is always between 0,16 and 0,31 p. 100, while the amount of phosphoric acid in the same is between the limits of 37 and 42 p. 100 (the ivory being an exception). The relation between the amount of fluorine with that of phosphoric acid in the normal apatite is found to be between 0,05 and 0,07 per cent, the exact average for the 20 analyses being 0,058.

Fossil Bones.—The following tables give the result of corresponding tests upon fossil bones, for comparison and to observe the modification produced by fossilization:

Complete Analysis.	1. Bone of Manatee, found in the peat deposits of Scania, Sweden. Plistocene Geol. Epoch.	2. Bone of Ox, from a Plistocene deposit in Cindre, Department of Allier, France.	3. Bone of Manatee from a Tertiary deposit, Tongrien stage, at Etrechy, Seine et Oise	4. A Vertebra of the Ichthyosaurus, from the Kimmeridgian clays of the Jurassic period; Havre, Seine Inferieure.	5. A silicified bone of a reptile from Bayreuth,* belonging to the Triassic period.	6. Debris of Fish from a breccia in the inferior silurian of Canon City, Rocky Mts., U. S. A.
Phosphate of Lime	64,63	79,05	68,53	12,90	....	67,70
Phosphate of Magnesia	1,97	0,65	2,27	....	....	....
Phosphate of Iron ($P_2O^5F^2eO^3$)	9,63	1,34	8,68	1,23	0,62	....
Peroxide of Iron	....	....	....	....	....	7,10
Fluoride of Calcium	0,88	1,70	3,82	3,42	traces	5,31
Chloride of Calcium	0,44	0,48	0,30	....	....	....
Carbonate of Lime	21,20	15,98	15,68	51,56	....	15,01
Silica	0,75	0,10	0,35	....	....	....
Sulphide of Iron (FeS^2)	....	....	....	24,92	....	....
Sulphate of Lime	....	....	....	4,23	....	....
Silica and Clay	....	....	....	1,57	....	....
Quartz	....	....	....	....	98,45	....
Organic matter	....	....	....	....	....	5,67
Loss on ignition	....	....	....	....	0,88	....
Total	99,50	99,30	99,63	99,83	99,95	100,79

*Note.—There remained of this only a thin crust of phosphate of iron, the central part was formed of crystals of quartz enveloped in a gray-blue quartzose mass, traversed by gray veins that served to bind together the phosphated envelope.

It is to be remarked that the first four analyses report only the mineral portion of the substance, the organic matters having first been abstracted; while in the last two, the organic

matter has been reported. The relative proportions between the fluorine and phosphoric acid will be set forth further on in these tests or assays and are classed according to their geologic deposits.

It is deemed proper to cite other tables made by other chemists and reported from standard works. This for the purpose of comparison:

Fossil Bones after Girardin and Preisser, reported in the *Annales de Physique et de Chimie*, 1843, Vol. 3, p. 370.

	Hygroscopic Water.	Organic matter.	Phosphate of Lime.	Phosphate of Magnesia.	Phosphate of Iron.	Carbonate of lime.	Fluoride of Calcium.	Silica.	Alumina.	
1. Metacarpal of Fossil Bear, Cavern of Mialet, Gard	1.30	7.17	75.45	2.81	....	12.18	1.09	....	....	100
2. Tusk of Fossil Elephant, Alluvial deposit at Saint Pierre sur Dives. (Calvados.)	....	traces	75.91	3.15	....	18.40	2.64	....	....	100
3. Vertebra of the *Plesiosaurus dolichodeirus* from the Oxfordian clay at Dives, Jurassic	2.20	4.80	54.20	4.61	6 40	10.17	2.11	9.21	6.30	100
4. Large bone of the *Poekilopleuron bucklandii*, quarries of Maladrerie, calcaire of Caen, Jurassic	....	1.30	71.12	....	0.12	25.31	0.86	1.29	....	100
5. *Ichthyosaurus*—Rib-bone, from the Dives clay	....	1.34	46.00	1.00	16.11	31.09	1.02	3.21	....	100
6. *Ichthyosaurus*—Rib-bone, from the chalk chlorite	....	8.19	76.00	1.08	0.70	10.00	0.12	3.01	....	100
7. *Ichthyosaurus*, skull, from the Jurassic	0.60	7.07	70.11	1.45	....	17.12	1.65	2.00	....	100
8. Bone of Manatee, from tertiary deposits near Valogne (Manche)	....	....	76.40	....	5.71	0.97	9.12	7.80	....	100
9. *Otaria jubata* (?) Straits of Magellan, S A.	....	1.17	61.19	0.95	....	14.48	22.21		....	100

It is to be noted that the last number given for the fluoride of calcium shows that the exactitude of these analyses are not always to be depended upon.

Fossil Bones after Mons. Fremy. *Annales de Physique et de Chimie*, 1858, Vol. I, p. 88.

	Ash.	Phosphate of Lime.	Phosphate of Magnesia.	Carbonate of Lime.	Silicious matters, and Fluoride of Calcium.	Organic matter.
1. A fossil Ox from Caverns of d'Oreston: the metatarsus with exterior part having the aspect of wood........	80.4	71.1	1.5	11.8	....	10.3
2. The same—interior having become friable..............	80.6	71.5	1.7	11.3	....	11.0
3. The same—spongy part..............................	84.2	6.33	1.2	5.2	17.2	8.0
4. Vertebræ of fossil Rhinoceros from Sansan, (Gers.)..	83 4	5.90	....	41.3	2.6	traces
5. The same—ribs....................................	83.1	6.68	....	27.5	1.4	traces
6. Long Bone of fossil Hyæna from Cavern of Kirkdale....................................	75.5	72.0	1.3	4.7	....	20.0
7. Dorsal Vertebra of fossil Rhinoceros..................	69.5	25.7	0.4	57.5	8.5	
8. Humerus of same....................................	73.0	32.4	0.4	64.0	6.2	....
9. Teeth of same......................................	90.4	65.2	0.7	13.8	14.5	....
10. Tusk of the fossil Mastodon.......	90.4	56.5	0.7	13.1	24.3	....
11. Bone of fossil Bear—solid part........................	83.9	59.7	0.4	23.6	9.8	....
12. The same—spongy part............	76.7	23.1	1.2	67.5	14.0	....
13. Fossil Armadillo, scales................................	80.7	55.0	0.4	23.8	12.4	....
14. *Anoplotherium*, fossil—vertebra of the tail............	84.0	53.1	0.4	20.4	19.4	....
15. Vertebra of the fossil Turtle............................	87.0	61.1	0.7	10.6	18.6	....

Observations.—The present composition of these fossil bones results both from their initial composition at the epoch when they belonged to the living animals, and the alterations incident to the diverse influences of atmosphere, soil and water during a long series of centuries. Comparing the results of these analyses of different modern animal bones, results with but feeble divergencies, we are authorized to believe that it was the same in past time and that the initial composition of the bone was practically uniform. The influences which have operated upon the fossil bones since they were buried in sedimentary deposits have produced modifications which are more or less important and quite varied. The proportion of organic matter has always been much diminished; from 35 to 40, which seemed to be the original proportion, it has descended in the process of fossilization from 6 to 12 per cent. These differences testify at the same time to the permeability of the earth by air and water, of infiltration and to the degree of compactness or porosity of the different bones or to the different parts of the same bone. The modification in the organic mat-

ter of the bones has not been examined, but the reader is recommended to an interesting study upon that subject by Mons. Scheurer-Kestner in the *Bulletin de la Societe chimique*, 1870, Vol. I, page 199, and Vol. II, page 11.

As for the mineral substances of these bones, the difference is sometimes small, but other times large from the initial composition. The proportion of carbonate of lime is generally increased, although in a measure extremely variable. The amount of phosphate of lime has frequently diminished, whether by reason of solution and infiltration of water or by the formation of phosphate of iron. The magnesia is found in proportion nearly identical to those which exist in the bones of living animals. The boneshave always retained a notable quantity of iron, whether in the state of hydrate of peroxide which colors them a reddish-brown, or in the state of phosphate of peroxide, rarely in the state of ferrous phosphate. The reducing actions have sometimes determined the deposit of sulphide of iron under the form of pyrites inattackable by hydrochloric acid. This has taken place notably in the vertebra of the *ichthyosaurus* from the Kimmeridgian clays of Havre. There is sometimes found in these bones, a certain quantity of sulphate of lime. The calcination with organic matter could give rise to the sulphur. The bones contain frequently a small quantity of clay or of silica in the form of quartz. They are also, though rarely, almost entirely transformed into crystalline or crystallized quartz; such is the case with the specimen from the trias at Bayreuth.

The chlorine is almost always in slight proportion in the fossil bones as well as in the modern, especially if one has taken care to eliminate by washing the soluble chlorides, and to leave only the chloride of calcium combined with the phosphate of lime. Fluorine is found always in a greater and more important quantity corresponding to several hundredths of fluoride of calcium. This salt forms with the phosphate of lime a nearly insoluble compound comparable to apatite; it appears to augment, in a certain measure, with the antiquity of the bones, so that one is able, up to a certain point, to find in the relative proportion of phosphoric acid and of fluorine, an index to the degree of fossilization.

 (*To be continued.*)

EXPERIMENTAL EVOLUTION AMONGST PLANTS.[1]

By L. H. Bailey.

De Varigny has written a most suggestive book upon Experimental Evolution, in which he contends for the establishment of an institution where experiments can be definitely undertaken for the purpose of transforming a species into a new species. "In experimental transformism," he writes, "lies the only test which we can apply to the evolutionary theory. We must use all the methods we are acquainted with, and also those, yet unknown, which cannot fail to disclose themselves when we begin a thorough investigation of the matter, and do our utmost to bring about the transmutation of any species. We do not specially desire to transform any one species into another known at present; we wish to transform it into a new species. . . . Experimental transformism is what we need now, and therein lies the only method we can use."

This is a most commendable object, and I hope that the attempt will be made to create a new species before our very eyes. This is what most people demand as a proof of evolution, and they are sometimes impatient that it has not been done; and it would seem, upon the face of it, that nothing more could be desired. When I reflect, however, upon the fact that this very thing has occurred time and again with the horticulturist, and consider that botanists and philosophers persist in refusing to see it, I am constrained to offer some suggestions upon De Varigny's excellent ambition. If I show a botanist a horticultural type of recent or even contemporaneous origin which I consider to be specifically distinct from its ancestors, he at once exclaims that is not a species but a horticultural variety. If I ask him why, he replies, "Because it is an artificial production!" If I show him that the type is just as distinct from the species from which it

[1]Abstract of an address before the Massachusetts Horticultural Society, Boston, Feb. 23, 1895.

sprung as that species is from its related species, and that it reproduces its kind with just as much certainty, he still replies that, because it is a horticultural production it cannot be a species. In what, then, does an accidental horticultural origin differ from any other origin? Simply in the fact that one takes place under the eye of man and the other occurs somewhere else! It is impossible at the present day to make a definition of a species which shall exclude many horticultural types, unless an arbitrary exception is made of them. The old definitions assumed that species are special creative acts, and the method of origin is therefore stated or implied in all of them. The definition itself, therefore, was essentially a statement of the impossibility of evolution. We have now revised our definitions so as to exclude the matter of origin, and thereby allow free course to evolution studies; and yet here is a great class of natural objects which is practically eliminated from our consideration because, unhappily, we know whence the forms came! Or, to state the case differently, these types cannot be accepted as proofs of the transformation of species because we know certainly that they are the result of transformation!

Now, just this state of things would be sure to occur if De Varigny were to transform one species into another. People would say that the new form is not really a species, because it is the result of cultivation, domestication and definite breeding by man. He could never hope to secure more remarkable transformations than have occurred a thousand times in the garden; and his scheme—so far as it applies to plants—is essentially that followed by all good gardeners. Or, if the prejudices of critics respecting the so-called artificial production of species could be overcome, he could just as well draw his proofs of evolution from what has already been done with cultivated plants and domesticated animals, as from similar results which might arise in the future from his independent efforts. I am not arguing against the scheme to create a species before our eyes, but I am simply stating what has been and is the insurmountable difficulty in just this line of endeavor—the inability of the experimentor to satisfy some scientific men that he has really produced a species; for it is a singular thing

that whilst all biologists now agree in defining a species upon its tangible and present characters, many of them nevertheless act upon the old notion that a species must have its origin somewhere beyond the domain of exact history.

This notion that a species, to be a species, must have originated in nature's garden and not in man's, has been left over to us from the last generation—it is the inheritance of an acquired character. John Ray, towards the close of the seventeenth century, appears to have been the first to use the word species in its technical natural history sense, and the matter of origin was an important factor in his conception of what a species is. Linnæus' phrase is familiar: "We reckon as many species as there were forms created in the beginning." Darwin elaborated the new conception—that a species is simply a congregation of individuals which are more like each other than they are like any other congregation—and with a freedom from prejudice which is rarely attained even by his most devoted adherents, he declared that "one new variety raised by man will be a more important and interesting subject for study, than one more species added to the infinitude of already recorded species." The old naturalists threw the origin of the species back beyond known causes; Darwin endeavored to discover the "Origin of Species," and it is significant that he set out without giving any definition of what a species is. I have said this much for the purpose of showing that it is important, when we demand that a new species be created as a proof of evolution, that we are ourselves open to the conviction that the thing can be done.

I have said that no modern naturalist would define a species in such terms that some horticultural types could be excluded, even if he desired that they should be omitted. Haeckel's excellent definition admits many of them. In his view, the word species "serves as the common designation of all individual animals or plants, which are equal in all essential matters of form, and are only distinguished by quite subordinate characters." It is impossible, however, to actually determine if one has a species in hand by applying a definition. One must show that his new type—if it is a plant—has

botanical characters as well marked as similar accepted species have, and these characters must show, as a whole, a general tendency towards permanency when the plant is normally propagated by seeds. He must measure his type by the rule of accepted botanical practice. If the same plant were found wild, so that all prejudice might be removed, would the botanist unhesitatingly describe it as a new species? If yes, then we should say that a new species had been created under the hand of man; and this rule I wish now to apply to a very few familiar plants. In doing so, I do not wish to be understood as saying that I consider it advisable to describe these plants as species under the existing methods of botanical description and nomenclature, for, merely as a matter of convenience and perspicuity, I do not; but I wish to show that they really are, in every essential character, just as much species as very many other universally accepted species are.

[The speaker then produced numerous instances of the evolution of forms of garden plants, in various genera, which are as distinct from their parents and from each other as accepted species of the same genus are; and these forms are as permanent, when multiplied extensively through many years by means of the seeds, as these wild species are. "Here we have absolutely new and unique types, as De Varigny demands, and they are as distinct from each other and from their parents, in accepted botanical characters, as 'good species' in the same genus are from each other, and they perpetuate these characters as unequivocally as those species do. Moreover, we know definitely what their origins were, and they therefore answer all the purposes of experimental evolution.

"All this is but another illustration of how tenaciously botanists still hold to the Linnæan idea of species, whilst they profess the Darwinian idea."]

I have now brought to your attention a few familiar plants for the purpose of showing that what are, to all intents and purposes, good species have originated in recent years; and that, whilst botanists demand that the origination of species within historic times shall constitute the only indisputable proof of organic evolution, they nevertheless refuse to accept

as species those forms which have thus originated and which answer every demand of their definitions and practice. The proofs of the evolution of species, drawn from the accepted practice of the best botanists themselves, could be indefinitely extended. We need only recall the botanical confusion in which most cultivated plants now lie, to find abundant proof of the evolution of hundreds of types so distinct that the best botanists have considered them to be species; but other botanists, basing their estimate of species upon origins, have reduced them or reincluded them into the form or type first described. Consider the number of species which have been made in the genus Citrus, comprising the various oranges, lemons, limes and the like. Recall the roses. The moss-rose and others would be regarded as distinct species by any botanist if they were found wild and if they held their characters as tenaciously as they do under cultivation. In fact, the moss-rose was long regarded as a good species, and it was only when its origin began to be understood that this opinion was given up. The earlier botanists, who were less critical about origins than the present botanists are, made species largely upon apparent features of plants, although their fundamental conception of a species was one which was created, as we find it, in the beginning. Yet, strangely enough, we at the present day profess to regard species as nothing more than loose and conventional aggregations of similar individuals and which we conceive to have sprung from a common ancestor at some more or less late epoch in the world's history,—we make our species upon premises which we deny, by giving greater weight to obscurity of origin than we do to similarities of individuals.

The fact is that much of the practice of systematic or descriptive botany is at variance with the teachings of evolution. Every naturalist now knows that nature does not set out to make species. She makes a multitude of forms which we, merely for purposes of convenience in classifying our knowledge of them, combine into more or less marked aggregations to which we have given the name species. Now and then we find in nature an aggregation of successive individuals which

is so well marked and set off from its associated groups, that we think nature to have made an out and out distinct species; but a closer acquaintance with such species shows that, in many cases, the intermediate or outlying forms have been lost and that the type which we now know is the remainder in a continuous problem of subtraction. In other cases, it appears to have arisen without intermediate forms, as a distinct offshoot from an older type. This is well illustrated in many remarkably distinct garden forms, which originated all at once with characters new to the species or even to the genus. I have mentioned such a case in the Upright tomato. Even the sudden appearance of these strange forms is proof that species may originate at any time and that it can be no part of our fundamental conception of a species that it shall have originated in some remote epoch. Species-making forever enforces the idea of the distinctness and immutability of organic forms, but study of organisms themselves forever enforces an opposite conception. The intermediate and variable forms are perplexities to one who attempts to describe species as so many entities which have distinct and personal attributes. So the garden has always been the bugbear of the botanist. Even our lamented Asa Gray declared that the modern garden roses are "too much mixed by crossing and changed by variation to be subjects of botanical study." He meant to say that the roses are too much modified to allow of species-making. The despair of systematic botanists is the proof of evolution!

I repeat that mere species-making, in the old or conventional sense, is an incubus to the study of nature. One who now describes a species should feel that he is simply describing a variable and plastic group of individuals for mere convenience' sake. He should not attempt to draw the boundary lines hard and fast, nor should he be annoyed if he is obliged to modify his description every year. This loose group may contain some forms which seem to be aberrant to the idea which he has in mind; and it would seem as if he should be ready to call them new or distinct species whenever, from whatever cause, they become so much modified that it is convenient, for purposes

of identification and description, to separate them from the general type. Just as soon as botanists come to feel that all so-called species of plants are transitory and artificial groups maintained for convenience in the study of nature, they will not ask whether they are modified outside the garden or inside it, but will consider groups of equal distinctness and permanence to be of equal value in the classification of knowledge, wholly aside from the mere place of their origin. At the present time, the garden fence is the only distinction between many accepted species and many discarded ones. The cultivation of man differs from the methods of nature only in degree, not in kind; and if man secures results sooner than nature does it is only another and indubitable proof of the evolution of organic forms. It is certainly a wholly unscientific attitude to demand that forms originating by one of nature's methods are species, while similar forms originating by another method are beneath notice.

If species are not original entities in nature, then it is useless to quarrel over the origination of them by experiment. All we want to know, as a proof of evolution, is whether plants and animals can become profoundly modified under different conditions, and if these modifications tend to persist. Every man before me knows, as a matter of common observation and practice, that this is true of plants. He knows that varieties with the most marked features are passing before him like a moving panorama. He knows that nearly every plant which has been long cultivated, has become so profoundly and irrevocably modified that people are disputing as to what wild species it came from. Consider that we cannot certainly identify the original species of the apple, peach, plum, cherry, orange, lemon, wine grape, sweet potato, Indian corn, melon, bean, pumpkin, wheat, tobacco, chrysanthemum, and nearly or quite a hundred other common cultivated plants. It is immaterial whether they are called species or varieties. They are new forms. Some of them are so distinct that they have been regarded as belonging to distinct genera. Here is the experiment to prove that evolution is true, worked out upon a scale and with a definiteness of detail which the

boldest experimenter could not hope to attain, were he to live a thousand years. The horticulturist is the only man in the world whose distinct business and profession is evolution. He, of all other men, has the experimental proof that species come and go.

OBSERVATIONS ON A SO-CALLED PETRIFIED MAN.

By J. M. Stedman.[1]

With a Report on the Chemical Analysis.

By J. T. Anderson.[2]

On the 28th day of August, 1894, a human so-called petrified body was found by some workmen while repairing a public country road about one mile south of Tuskegee, Macon Co., Alabama. A few days later I heard of the find, and immediately proceeded to Tuskegee to make an investigation of the body and of the locality where it was found, and to obtain samples of the water, earth and body.

Through the kindness of Mr. J. S. Webb, who had the body in charge, I was enabled to make an examination on, and to procure portions of the body from the several places as samples. As Mr. Webb was trying to sell the body as a curiosity, he did not wish me to mutilate it any more than was necessary. I obtained, however, portions of the intestine, a section 75 x 25 mm. through the ventral abdominal wall, several pieces of muscle with tendon from the ankle, and a section 100 x 100 mm. was cut out from the dorsal region of the thigh and extending to the bone in thickness. Mr. Webb, by the way, offered me the body for the college museum for $75, but, as I hoped to be able to procure it later as a donation, I refused. He sold the body in a few days for $150, and it is now being exhibited in the villages and cities of the country, much to my regret.

The body is that of a Negro woman who was evidently rather fat. From two elderly gentlemen, who are now living in Tuskegee, and who remember the circumstances of the burial, I learned that the body was buried in 1837 in what was

[1] Professor of Biology in Alabama Polytechnic Institute, and Biologist of Experiment Station.

[2] First Assistant Chemist of Experiment Station.

then a small neglected country or family burying-ground, situated a few rods from the road. They also remember the burial, at about the same time, of an Indian but a few feet from this Negro; and I am trying to have the Indian dug up to ascertain whether it is likewise preserved or not.

In company with several citizens of Tuskegee I drove to the scene of the find. The burial ground is near the top of a very large flat hill or plateau, and a few rods south of the grave is a small marshy or swampy bog, while some seven meters to the east there is a spring. Several years ago the public road was moved a few rods to the south in order to give it a better grade up the hill, and as the small, neglected burial ground had not been and was not worth keeping up, and was no longer used as such, the road was cut through a portion of it; and most people had now forgotten about its existence. The road was cut about one meter below the surface, and the ditch at the side was directly over the Negro woman's body, and served to carry off the water from the spring just above. The result was that the body lay but about one-third of a meter below the ditch, and the water from the spring kept it continually wet, even when no water appeared on the surface. While the workmen were repairing the road and picking in the ditch, they hit something that proved to be a pine board. On removing it they came upon others, which they removed, and thus exposed a plain pine coffin in a remarkable state of preservation.

The soil where the body was found is sandy, with enough fine, light-colored clay and moisture to give it the appearance of mortar. When a portion of the soil was dried, it held together with great tenacity, and the dirt left on one's hands became nearly white on drying, and felt smooth and slippery like powdered talc; in fact, I could detect no difference as regards looks or feeling. Portions of the soil had streaks of red color, probably due to iron. The hole left by the removal of the coffin soon filled with water, the soil being extremely wet, although very little moisture appeared on the surface on account of excessive dry weather. The water had a decided milky appearance. I obtained samples of the soil from the bottom of the hole, from the sides, and from the earth just

above; and also samples of the water from the hole. These were placed in thoroughly clean jars brought for the purpose.

The first thing to be noted is the fact that the boards that covered the coffin, as well as the coffin itself, were in a perfect state of preservation—not a sign of decay was to be found. They looked like newly-planed boards that had been exposed to the weather for about six months; just long enough to partially color the wood gray. The nails in the coffin had all rusted away.

On opening the coffin, the body of the Negro woman was found to be in a remarkably good state of preservation. Of course it was saturated with water, but, nevertheless, it was firm like hard cheese, so that the workmen pronounced it petrified when they touched it, and found it would not give or bend. In general, the body at first glance has very much the appearance of sheet asbestos, being dirty-white in color, with a certain grain in places, due to the connective tissue in the fat where the skin is wanting. The abdomen and to a certain extent the thorax is swollen and bloated, so that part of the abdomen pressed tight against the top of the coffin, thus showing that decomposition had started when the body was first buried, and had continued for a short time. It is to be noted that no part of the body was decomposing when found, and it has shown no signs of doing so since; neither does it smell—all decomposition that had taken place was now checked. The head is not well preserved, part of the cranium having been decomposed, and other parts partially so, and more or less separated. All the hair, with part of the scalp is, however, well-preserved, while the face had been partially decomposed. One wrist and both ankles had been badly decomposed, and part of the feet and one hand slightly decayed. Some of the toe and finger-nails were perfect, others partially or wholly decayed. The rest of the body is practically intact and well-preserved, except that in places the skin is wanting; but this does not make itself apparent to the ordinary observer.

With a scalpel I cut through the ventral abdominal wall from right to left, and then cephalad at the two ends. The body at this place cuts very much like dense cheese. The cut

portion was then lifted up and turned back, thus exposing the viscera beneath. The intestines, and in fact all the viscera, were only partially preserved. They had become more or less decomposed, and had then been checked in their decomposition and preserved in that state from further change. There was no particular smell from the abdominal cavity, and no decomposition was in progress. The intestines were moist, loose and pliable, and the fœces still preserved in them. All the viscera were light in color, due to the partial deposition in them of the finely-suspended, and perhaps more or less soluble, mineral matter in the water that filled and covered the body. The deposit of this mineral matter was not in sufficient quantity to give the tissue much firmness.

The abdominal wall which was cut through in order to examine the viscera, was 30 mm. thick, and owed its dense, cheese-like consistency and firmness to the deposition in it of the finely suspended mineral matter contained in the water that constantly saturated the body. The abdominal wall was practically completely charged with the mineral matter, while the process of filling the viscera had but nicely commenced. The mineral matter was extremely fine and of a light or almost white color, and thus it was that the body appeared light. So far as I was able to determine, this mineral matter in the tissues of the body is the same as that held in suspension in the water, and which gave it the milky appearance; and also that which in the soil or sand gave it the appearance of mortar, and that when dry, looked and felt exactly like powdered talc. With the exception of the fat, the tissues of the abdominal wall were practically intact, the mineral matter simply saturating them and filling up all the spaces; in the fatty tissue, however, which composed a large part of the abdominal wall at this point, there had been more or less substitution of the mineral matter for the fat. This substitution was, roughly speaking, about half and half. Hence it was that where the skin was wanting, there appeared a grain, due to the connective tissue remaining, while the fat was partially substituted. Wherever the skin was preserved, the black pigment could be distinctly seen in a cross-section.

In cutting and then removing the 100 x 100 mm. piece from the back of the thigh, I was surprised to find that the deposition of mineral matter had taken place to the extent of 25 mm. in depth, and that from this point inward the muscular, connective and other tissues were in such a perfect state of preservation, that they looked and felt exactly like fresh corn-beef. The flesh or muscle was of a dark red color, and of a perfectly natural and fresh consistency, showing no signs whatever of having undergone the slightest decomposition; it did not emit any more odor than fresh meat. The perimyseum appeared perfectly natural, the tendons glistened as well as the perimyseum near them, and the connective tissue was, to all appearances, as strong and well preserved as one could expect to find it in a body dead but twenty-four hours. On teasing the muscles, the fasciculi held together perfectly naturally, and the only difference besides color that I could then detect between this muscle and a perfectly fresh one was that this appeared to have a little more firmness, but it was very slight, and if compared with fresh corn-beef this difference disappears. It is also to be noted that the external layer, averaging 25 mm. in thickness, where the deposit and substitution of mineral matter had taken place so completly, and which covered the entire body and gave it its consistency, that this region was quite sharply marked off from the region below. In other words, the deposition and substitution of mineral matter had taken place to the extent of about 25 to 30 mm. in depth all over the body (wherever examined it was of this depth), and rendered this portion very dense, tough and firm; and, instead of gradually merging into the soft almost unchanged inner portion, the change was quite abrupt. From an examination of the abdominal wall, I at first supposed this abrupt and sudden change to indicate and be due to the region of fatty tissue, but I found, on further examination, that the abrupt change took place in the muscular tissues of the thigh, where little or no fat was to be found.

On reaching my laboratory, I made a microscopical examination of the samples of tissue by means of sections and teased preparations, in order to determine the extent of the preserva-

tion of the histological structures. I found that the skin was nearly substituted by mineral matter in most places, and in some wholly substituted. The fatty tissue was also substituted by mineral matter to the extent of about 50%. The muscular tissue, where the deposit of mineral matter was greatest, did not seem to have been replaced to any considerable extent, but was simply saturated with the deposit. Where the muscles were still soft, the fasciculi, and even the fiber cells with their striæ, were remarkably well preserved and easily demonstrated. The perimyseum and tendons were practically perfect. The connective tissue was surprisingly perfect, the only change being the loss of the connective tissue corpuscles in many places; but even these were found in the better preserved soft muscular tissue. The nerves were not well preserved histologically. The blood-vessels in the soft muscles were fairly well preserved; the blood-corpuscles were not to be found. The periosteum and the bone was perfect, except in those regions like the head and ankles where decomposition had taken place.

I then examined, by the agar-agar plate culture method, the muscular tissue for bacteria, and found none. The water taken from the hole, left by the removal of the coffin, also failed to reveal the presence of bacteria on an agar-agar plate culture of 1 cc. of the water.

A piece of the soft muscular tissue from the thigh was then placed in a museum jar of water from the grave. This jar was opened every few days for more than a month, and the muscle taken out to show it to visitors. The water, jar or muscle had not been sterilized; no caution was taken, in opening the jar, to close it for some minutes, nor to protect the piece of flesh. I did this in order to determine how long it would keep under those conditions, and I therefore watched it and made examinations from time to time. To my surprise, the piece of muscle is this day, the 15th of December, 1894, of a reddish color and looks quite natural, but I now find, on examination, that it is becoming softer, and that bacteria have made their ap-

pearance, so that the tissue will ultimately decompose[3]. It was this test that I wished to finish that prevented me from publishing this article just as soon as the chemical analysis was completed.

The large piece cut from the thigh was placed in an empty museum jar in order to keep it as moist and natural as possible, and to observe how long it would thus resist decomposition. The piece was frequently taken out of the jar to allow visitors to examine it. I found, in about two weeks, that a small mould was making its appearance on the surface, and I then cut it in halves, and placed one in alcohol and the other on my table and allowed it to dry. Of course the specimen in alcohol is preserved, although it does not look natural; it has become darker colored, and the flesh has shrunken and become harder, while the hard external region of greatest deposition of mineral matter has become much softer. The specimen exposed on the table dried in a few days with the usual changes, and is now preserved in that state, and shows no signs of moulding or decaying. The entire body is now dry, and will keep, no doubt, indefinitely in that condition.

Of course the greatest interest attaches itself to the question of the cause that checked decay and preserved this body for 57 years, with the certainty, I might say, of doing so indefinitely, and, perhaps, of ultimately converting it into a hard fossil by substitution. It was with this object in view that I obtained samples of the water and earth from the grave, and gave them to Dr. Anderson for chemical analysis, and also portions of the body itself for chemical analysis. And, now that the analysis of all these has been made, I must confess I do not see my way clear. I cannot understand why decomposition should not have continued on the inside until the viscera and muscles were obliterated. The body seems to have acted like a filter, and to have taken out and held in itself the finely suspended, and perhaps also some soluble mineral substances in the water. This filtration naturally saturated the

[3] Since writing the above the proof has just reached me (11th of March, 1895), and as nearly three months have elapsed since the observation was made, it may be of interest to note that I have kept the sample of flesh on my desk ever since, and that it is to-day only partially decayed.

external layers of tissue first, and, when found, had not extended far inside. I think I can understand, then, why it is that the external tissues are preserved, but I do not understand the preservation of the inner tissues. I do not believe that the small amount of lead found in some portions of the body itself can account for the preservation. Can it be that the silica, alumina and oxide of iron held in suspension, and the silica, lime and magnesia in solution in the water could have prevented decomposition? The three ingredients, silica, alumina and magnesia constituted the bulk of the mineral substances deposited in the tissues, and that near the periphery, was in sufficient quantities to give it a firm consistency. The soil contained nearly 3% soluble silica, and the water contained a large percentage; but can this account for the preservation? The observed fact is that the body was preserved and decay completely checked, and I can only account for it by saying that the combined action of all the ingredients of the water—silica in suspension and in solution, alumina and oxide of iron in suspension, and lime and magnesia in solution—is to be looked upon as the cause.

And, what is still more obscure, is the fact that the body was buried with a shroud (or some clothes), while all that now remains of it is the imprint nicely stamped on that part of the abdomen that had swollen and pressed closely against the lid of the coffin, and also on the lid of the coffin where some of the mineral matter is adhering. Every thread of the cloth is as plainly visible in the impression as it is possible to make them with plaster casts. It appears to have been a cotton sheet, but not a fiber of the original cloth is to be found. Now, why was this cloth not preserved? If it was cotton cloth, its chemical composition was practically the same as that of the pine coffin which was perfectly preserved; if the cloth was woolen (there can be but little doubt that it was cotton), its chemical composition was practically that of the hair which was also perfectly preserved. I cannot account for this to my own satisfaction, and will offer no suggestions; to me, this is more difficult of explanation than the preservation of the body.

Through the kindness of Dr. Anderson, First Assistant Chemist on the Experiment Station, who made the chemical analysis of the water, soil and body, I am enabled to submit herewith his report on the same:

With a view of determining the agency by which the body was kept in so excellent a state of preservation, the soil in which the body was buried, the water which percolates through the soil from the spring above, and the flesh from the body itself were all subjected to chemical analysis.

The soil presents no peculiarity in its composition, further than it is a highly silicious soil. It contains 95.91% of insoluble residue, and 2.94% of soluble silica, thus giving nearly 99% of silicious matter. Next in importance as regards quantity comes alumina and oxide of iron—nearly 1%—and then lime, magnesia, and the alkalies in minute quantities.

When found, the coffin containing the body was submerged in water, and when the coffin was removed, the hole soon filled with water. A sample of this water was taken for analysis. After remaining in the bottle undisturbed for four or five weeks, a considerable sediment, chiefly of sand, formed in the bottom, but the supernatant liquid remained decidedly milky in appearance. The suspended matter which caused this milkiness was found to be silica and alumina, with oxide of iron. The water presented no other peculiarity, but contained lime and magnesia.

Naturally, the chief interest attaches to the chemical examination of the flesh itself. To preserve the specimen in the condition in which it was found, it was kept in a bottle with a ground glass stopper. Determinations were made of water, fat, organic matter other than fat, and ash. From a number of determinations the following averages are taken: Water, 55%; organic matter, 44%, 32% of which was fat; and ash, 1.22%. The least amount of mineral matter found was 0.33% and the largest, 2.10%. It was found to contain silica, alumina, oxide of iron, lime and magnesia. But, in my estimation, the most important find was lead. This was not found uniformly distributed throughout the specimen. From two to three grams of the flesh were used in each determination. In

two of these samples not a trace of lead could be found; in three or four others a perceptible quantity was obtained, while in one a sufficient quantity was gotten to make a metallic bead. There can be no doubt, therefore, that lead in some form exists in the body. It was found in a part of the specimen which had been kept several weeks in alcohol, and hence must have been incorporated with the tissues of the body.

Whether lead was the sole agency in the preservation from decay, I cannot say; but that it exerts an influence in that direction cannot, I think, be doubted. It is recorded that a solution of sugar of lead, among other things, were used as an embalming fluid during the Civil War. It is hardly probable that the body in question was embalmed, as it is that of a Negro; but some salt of lead may have been administered as a medicine. It is well-known that lead is a "cumulative" in its nature—that is, when taken into the system from time to time, even in small quantities, it is not thrown off as is usual, but is retained in the system and thereby accumulates. May not the presence of lead in the body under examination be accounted for in this way? It is a matter of regret that reliable facts relating to the history of the case before us are unattainable.

ON THE VALIDITY OF THE GENUS MARGARITANA.

BY CHAS. T. SIMPSON.

In 1817, Schumacher founded the genus *Margaritana*[1] for the *Mya margaritifera* of Linnaeus, the *Unio margaritifera* of subsequent authors, on account of the fact that, whereas the shells of the latter genus had both cardinal and lateral hinge teeth, this species had only the cardinals. Say's *Alasmodonta*, applied in 1818[2] to other Naiads having similar teeth, is synonymous. A number of forms have since been added to the groups, mostly by Dr. Lea, and, as it stands to-day, it includes some 26 or 27 species, all confined to North America, with the exception of the type, which is circumboreal.

The soft parts of the different members of this assemblage do not differ generically from those of *Unio*, and any separation from that genus can only be founded on the character of the teeth which I have mentioned. The Margaritanas do not, taken as a whole, form a natural group, but are, undoubtedly, polyphyletic in their origin, several of them being evidently much more nearly related to certain Unios than they are among themselves; and it is only reasonable to suppose, when the facts are all carefully considered, that most, if not all the species, have sprung from different groups of Unios.[3]

The genus *Unio* may be divided into a large number of sections, which are, I think, unworthy of subgeneric rank, but which consist of species that are shown to be closely related by characters of the animal and shell, by habits and the facts of their distribution. In a majority of these groups, though certain species may be considered fairly typical, a close relationship is shown to other groups by species which seem to stand

[1] Essai d'un Noveau Syst. des Habits, des vers Testaces, p. 137, 1817.

[2] Journ. Phila. Acad. Nat. Sci. I, p. 459, 1818.

[3] The earliest recorded species referred to Margaritana is, I believe, the *M. nebrascensis* Meek (Rep. of the U. S. Geol. Surv. of the Territories, Vol. IX, p. 114, 1876), from the Upper Missouri Cretaceous. The genus Unio is now believed to date back into the Triassic.

between and partake of the characters of two or more assemblages; sometimes to that degree that they might, with equal propriety, be placed in either of two or three sections. The same thing is true of the Margaritanas to some extent, and, while a few of the divisions of this so-called genus do not seem to be very closely related to anything else, others show such strong affinities to certain groups of Unios, that they will have to be placed with them in anything like a natural arrangement.

In the Mississippi Valley and on the Atlantic Slope, there is found a small group of Unios fairly typified by *U. pressus*, which consists of compressed, rather quadrate or rhomboidal shells, with strongly undulate beaks, and faintly rayed green epidermis. In the right valve of all these forms, the hinge plate is cut away directly under the beak, and there is a long, curved lateral, and a tolerably perfect, compressed cardinal, the latter separated from the edge of the shell by a deep, parallel sided socket. In the left valve is a somewhat triangular, recurved cardinal, which exactly fits into and fills up this missing area in the hinge plate of the opposite valve; another cardinal fills the parallel sided socket, and there are a couple of usually somewhat blurred laterals. In this group I should place *Unio pressus, tappanianus, charlottensis, neglectus*, and possibly one or two others.

Now *Margaritana rugosa* bears so strong an external resemblance to *Unio pressus*, that one is often taken for the other by persons familiar with the species; the principal difference being that the former is generally somewhat corrugated on the posterior slope, while the latter is without this sculpture, though this distinction does not always hold perfectly good. The arrangement of the teeth is precisely the same in both, but in the *Margaritana* the hinge plate is a little heavier, and the laterals are more blurred or imperfect. Dr. Lea carefully examined specimens of the animals of both, and it will be seen that they are very much alike by the descriptions which I give in his own language. Recently, Dr. V. Sterki, a careful anatomist of New Philadelphia, Ohio, who has dissected these species, has reached the conclusion that they are very nearly related.

LEA'S DESCRIPTION OF *Unio pressus* AND *Margaritana rugosa.*

Unio pressus Lea.	*Margaritana rugosa* Bar.
Branchial uterus occupies the whole of the outer branchiæ.	*Branchial uterus* occupies the whole of the outer branchiæ; brownish, forming a large, massive lobe which extends below the margin.
Branchiæ large, rounded below, free nearly the whole length of the abdominal sac.	*Branchiæ* very large, rounded below, the inner ones much the larger, free nearly the whole length of the abdominal sack.
Palpi small, subangular, united half way down the posterior edges.	*Palpi* rather small, subtriangular, united nearly one-half way down the posterior edges.
Mantle thin, slightly thickened on the margins.	*Mantle* rather thin, much thicker at the margin, blackish on posterier basal edge.
Branchial opening large, blackish on the edge, and with numerous papillæ.	*Branchial opening* rather large, with small, brown papillæ.
Anal opening rather small, blackish, and without papillæ[4].	*Anal opening* rather large, without papillæ.
Superanal opening rather large, united for some distance below, blackish on the edges.	*Superanal opening* very large, with a dark brown line within, united below.
Color of the mass dirty white.	Color of the mass salmon.
Embryonic shell subtriangular, light brown, has hooks.	Embryonic shell triangular, brown, has hooks.

[4] Agassiz claimed that two distinguishing characters of the genus *Margaritana* were (Archiv. fur Naturgeschichte, 1852, I, p. 41) that certain species had gills free from the mantle at their posterior extremities, and that the anal region was not fringed, while in the typical Unios the branchiæ and mantle were united posteriorly, and that both siphonal openings had papillae. According to this, *Unio pressus* and its allies, though having lateral teeth, would be Margaritanas.

It is probable that when Dr. Lea described these two animals, he never thought of their being closely related, yet, with a few trifling exceptions the description of one would answer for the other. In *Margaritana complanata*, which is a somewhat solider, more rounded species, there is essentially the same arrangement of the teeth, the beak sculpture is exactly like that of the group, and specimens are occasionally found which approach *Unio pressus* in form. *Unio charlottensis*, a member of this section, is shaped much like *Margaritana complanata*, and the characters of the animal of the latter show that it is closely related to the other species of the group.

In the section typified by *Margaritana margaritifera*, we have a set of Naiads all having elongated, usually arcuate shells, with black, rayless epidermis. They have commonly two more or less perfectly developed cardinals in the left valve, and one in the right; the hinge plate is elongated, narrow just behind the cardinals, but becoming heavier near the posterior end, and generally rounded on its inner face. All the species which I place in this group have a rather wide border of the prismatic outer layer of the shell projecting beyond the nacre, and which is plainly visible from the inside, and all occasionally have dark-colored blotches on the nacre. I include in it *Margaritana margaritifera* Linn., having a circumboreal distribution; *M. hildrethiana* Lea, of the central Mississippi region; *Unio monodontus*, found in the same territory as the last; *Unio decumbens* Lea, of Tennessee and Northern Alabama; *Unio hembelii* Con., of Louisiana; *Unio crassus* Retz., of Southern Europe, and *U. laosensis* Lea, of Southeastern Asia. In *Margaritana hildrethiana*, there are seldom any laterals, while *M. margaritifera* often has them more or less perfectly developed. A lot of the latter in the National Museum (Museum No. 60,878) from the State of Washington, have a single, well-developed lateral in each valve, while two specimens in the Lea collection, one from Maine (Mus. No. 86,285) and another from Massachusetts (Mus. No. 86,286) have as perfect cardinals and laterals as any *Unio*. *Unio monodontus* usually has the cardinals more or less blurred, and sometimes in old specimens they are reduced to mere tubercles or are even ob-

solete, while a good series of shells will show every variation from those with no laterals at all, to others in which they are perfect.

The latter species has been placed by some authors in *Unio* and by others in *Margaritana.* In *Unio decumbens* and *hembelii* there is a somewhat better development of laterals, though they are often not quite perfect, while in *U. crassus* and *laosensis* both cardinals and laterals are like those of ordinary Unios. Here then in a group of Naiads, which at least by the shell characters appear to be closely related, we have every variation from species which occasionally have neither cardinals or laterals to those in which they are perfect.

So far as is known the animals of these different species do not greatly differ, and Lea's description of that of *Margaritana margaritifera* would almost exactly answer for that of *Unio monodontus.*

Margaritana confragosa, a species found sparingly throughout a considerable part of the Mississippi drainage basin cannot be referred, I think, to any group of Unios, but it evidently has a much closer relation to the *Asperrimus* and *Plicatus* groups than to any Margaritanas. This relation is shown in the form of the shell, which is like that of the species of both of these groups, and by its sculpture, there being two rows of tubercles radiating from the beaks after the manner of those of *Unio asperrimus,* and the body of the shell being plicate as are all the members of the Plicate group. The hinge of this species seems to have become somewhat degenerated or weakened, as it is of unusually light structure for so heavy a shell, and such teeth as appear are generally somewhat compressed. In some specimens the posterior cardinal of the left valve is recurved and cut into serrations on its edge, and fits into a somewhat open space under the beak of the right valve, something after the manner of the *Pressus* group. It will be found in occasional specimens of the *Asperrimus* group that this posterior cardinal though much heavier, is recurved and serrate on its edge, and that there is a partial corresponding break in the usually wide hinge plate of the right valve. But in a large series of *M. confragosa* almost every variation may be

found from a narrow to a heavy hinge plate, and the same is true among the Unios I have just mentioned.[1]

Margaritana holstonia and *M. georgiana*, the latter being perhaps synonymous with the former, so closely resemble some of the Unios of the group typified by *U. nashvillensis* that Dr. Lea himself sometimes referred specimens of them to some of these species, and their only essential difference is that they are generally destitute of the lateral teeth which are present in the Unios.

Such species as *Margaritana raveneliana, spillmanii* and related forms have no laterals, and only partially developed cardinals. In most of the specimens the hinge line is incurved in the region of the rudimentary cardinal teeth, exactly as in the so-called *Anodonta edentula* and its allies, all of which bear close relationship to them, and I believe that they should all be placed in the genus *Unio*, since their animals, so far as is known, agree well with those of that genus.

[1] Lea's description of the soft parts of *Margaritana confragosa* agrees very closely with that of *Unio lachrymosus*, which is synonymous with *U. asperrimus.*

Unio lachrymosus Lea.	*Margaritana confragosa* Say.
Branchiæ very large, inner ones very much the larger, rather thick, very much rounded below, free nearly the whole length of the abdominal sack.	*Branchiæ* very large, nearly semicircular, inner ones much the larger, free the whole length of the abdominal sack.
Palpi very large, transverse, rather thin, subelliptical, united half way down the posterior edges.	*Palpi* very large, pendant, sublunate, united half way down the posterior edges.
Mantle rather thin, with a broad thickened margin.	*Mantle* rather thin, with a thickened broad margin.
Branchial opening very large, with numerous rather small, branched papillæ.	*Branchial opening* rather large, with numerous small, brown papillæ.
Anal opening rather small, without papillæ.	*Anal opening* very small, with very minute papillæ.
Super-anal opening very large, slightly colored on the edges, united for a small distance below, color of the mass whitish.	*Super-anal opening* large and united below, with a dark line on the inner edges. Color of the mass whitish.

The above are Lea's descriptions of the two species.

It would be very interesting indeed to know the exact cause of the obliteration of the teeth of these so-called Margaritanas. The teeth of the Naiads seem to be peculiarly susceptible to injurious influences, and many cases among them somewhat similar to that of the Margaritanas might be cited. In *Cristaria*, a Chinese and Japanese group, the cardinals are generally though not always obsolete, while the laterals in young or merely adult shells are developed. Old specimens are frequently without teeth, like the Anodontas, in which case they are probably absorbed in the process of growth. There is a group of peculiar Naiads found in the East Indian Archipelago, typified by *Unio bengalensis* Lea, of thin structure and lurid purplish or reddish color throughout, having a wide, internal prismatic border visible. In all of them the teeth when present are greatly compressed, and they occur in various stages from a perfect condition to almost complete obliteration, so that the species have been divided up between *Unio* and *Anodonta*. The fact that certain specimens of a given species in the group may have well developed teeth, while in others they may be almost completely wanting leads me to place all the species, which seem to form a very natural group, in *Unio*.

Pseudodon is another genus in which it is quite probable the teeth have degenerated from some cause until in most cases only a single, rounded tubercle, answering to a cardinal, remains in each valve, and one of the Chinese Naiads *Unio biasianus* is a perfect *Margaritana* with blurred laterals like *M. rugosa*, though the species probably groups with the well known *Unio sinensis.* And it is likely that *Bourguignat's* genus *Cameronia*, in which the shell is only toothed behind the beaks, is a depauperate state of *Pleiodon*, a genus in which the teeth are found throughout the entire length of the hinge plate. It is a fact that those species of Unios which seem most closely related to the Margaritanas usually have more or less imperfect laterals, and sometimes feeble or blurred cardinals.

In many localities a large proportion of the specimens of one or more species of *Unio*, especially adult or old shells, while apparently healthy in every other way show diseased hinges in which the epidermis is folded in and greatly pro-

duced, and the teeth and plate are badly injured. And the erosion of the beaks so common to Naiads in many streams usually damages the teeth.

There seem to be two forms of hinges among the so-called Margaritanas, the one like that of *M. margaritifera* and *holstonia*, in which the area occupied in the Unios by the laterals is smooth and destitute of teeth, the other like that of *M. complanata* and *calceola* in which the laterals are badly blurred and broken up as if by disease; the plate being covered with long, low, irregular ridges which run somewhat diagonally across it from the region of the beaks towards the interior of the shell. I would suggest that different causes may have operated to produce these different conditions. Dr. Dall holds, and I believe with good reason, that the teeth of bivalve shells are developed for the purpose of keeping the valves in their proper place. In such cases as they interlock it is well-nigh impossible that one valve should be twisted out of place without injuring the animal or its shell. Nearly all Unios which have strong, perfectly developed teeth live in running water, often in rapid currents, in fact it is well known that the Unios are more generally inhabitants of streams and rivers while the Anodontas, which have no teeth, live as a rule in ponds or other still waters. The different species of *Cristaria*, in which the teeth are reduced to mere rudiments, live in ponds and the ditches of rice fields, in the mud. *Unio hembelii*, with very faint laterals is found in the sluggish bayous of Louisiana. *Margaritana monodonta*, which is often nearly destitute of teeth, though living in rivers is almost invariably found under stones in mud, as is *M. hildrethiana;* both of them therefore being protected from currents. I think that the want of teeth in such forms can be explained by supposing that they have degenerated on account of their being no longer needed.

Such species as *Margaritana confragosa, rugosa, complanata* and the like, which have blurred or distorted teeth usually are found in running water, often in rapid streams, and I am inclined to believe that they are forms which are peculiarly susceptible to injurious influences, and that their teeth have become diseased on account of these influences. And it seems

to me not improbable in certain cases, where water and other elements of environment appear to be favorable for producing normal conditions of the hinge, that the fact of this part of the shell being nearly always blurred and distorted goes to show that the diseased condition has become more or less fixed and is inherited.

Be this as it may the evidence of the shells and soft parts seems to show clearly that *Margaritana* is not a valid genus, but that the name merely stands for certain groups or parts of groups of Unios of polyphyletic origin, and that all the species will have to be relegated to the genus *Unio.*

EDITOR'S TABLE.

—The evolutionary doctrine leads us to expect that definitions of natural divisions as genera, families, orders, etc., will be ultimately rendered inapplicable through the discovery of intermediate forms. This result has, to some extent, followed paleontologic discovery. The abolition of definitions, however, can never be complete, and many will remain in accordance with the doctrine of "expression points." Evolution of characters, while gradual at bottom, ceases to be so in expression, when two or more stimuli coincide to produce something more than the arithmetical sum of the two might lead one to expect. Moreover, there are many "expressions" which only become apparent at a definite stage of development. The eruption of a tooth, for instance, is only accomplished when the line of the alveolar border is passed by the base of the crown as it rises. Yet the growth was, perhaps, uniform throughout. Especially has the "law of release" of energy probably often operated to render the immediate appearance of a structure possible, although the approach to the point of release may have been uniform and gradual. These facts are opposed to the view that systematic divisions are phylogenetic lines. The former run transverse to the latter, and are generally polyphyletic.

These remarks are apropos to the frequent carelessness exhibited by some modern writers in the use of systematic terms, family subfamily, ordinal names, etc., who use without reference to their relation to the divisions which have long borne, and must necessarily bear, those names. New names are used for divisions already named, or so nearly covered by old names that the creation of new ones is inexcusable. In the hands of some authors, almost every conspicuous genus becomes the type of a new family. Such authors are frequently at no pains to define the divisions thus proposed. The chief sinners in this direction appear to be the paleontologists and embryologists, who are sometimes unfamiliar with systematic biology. In the midst of this carelessness, it is pleasant to refer to the Catalogues of the British Museum issued of recent years. So far as regards the Vertebrata, while we cannot praise their treatment of the North American species, in their systematic work there is conservatism and conscientiousness, which is worthy of imitation everywhere.—C.

—There is still a lack of appreciation on the part of the benefactors of their fellow citizens of the importance of original research.

Although many facts of detail are known, few general laws are fully established, and fewer are fully understood. Before we shall grasp the laws of nature, much research will be necessary. The unexpected character of some modern discoveries furnishes ample evidence that research is the only key to knowledge, and that until our hypotheses have the support of abundant facts we must not value them too highly. An illustration of the failure of speculation to anticipate discovery, is the knowledge that various growth functions are carried on by free and wandering cells, who act as carriers of substances to and from tissues. Research in all directions in fact, meets with such reward that it should be sustained by all persons who desire to encourage the progress of knowledge. But the rich men of our country do not discriminate between this function or that of teaching. They found Universities with praiseworthy and princely liberality, but research has to struggle with poverty of means and deficiency of time. Great libraries are founded, but the work in the laboratory from which issue the books which create libraries, receives comparatively little substantial encouragement. It is also the fact that the general public does not discriminate between the distributor and the producer of knowledge The compiler is often mistaken for the discoverer. The education offered in our Universities will correct this in many minds, and then later other facts will have to be understood. This is, that the mental peculiarity which belongs to the discoverer, is not a general one. Every naturalist of long experience will recall the numbers of men who have entered this field to leave it. Men who take a course in a foreign University and write an original thesis for a degree, frequently never make another contribution to science. These are not the men to endow as original investigators. The combination of good sense-perception with memory and systematic skill, along with perseverance and the comprehension of ways and means, with an idealism which justifies the end in view, is not very common ; and presumably, when present, is often suppressed by adverse circumstances of life. Initiative and discovery are the condition of progress, and no better service could be rendered to humanity than the creation of opportunities for their activity.

One of the principal fields of future discovery is the Antarctic continent. No one has approached nearer to the South Pole than 65° S. so that the unexplored region is at its narrowest point greater in width than the continent of North America. While the possibilities of botanical and zoological discovery in such a region, under the rigorous

climatic conditions that prevail there, is less than on any equal area of the earth's surface, they must be nevertheless considerable. But the immense additions which will accrue to geology and the climatic history of the earth in past ages cannot be overestimated, and the probability of important additions to our knowledge of ancient life is great. It is to be hoped that the projects now on foot in this country and elsewhere for Antarctic exploration will be sustained in such a way as to insure their success. An Antarctic expedition should be furnished with every facility for collecting on land and sea, including apparatus for deep sea dredging.

In his account of the Cold Spring Harbor Laboratory, published in the last number of the Naturalist, Professor Conn seems to mistake the field and purpose of the Marine Biological Laboratory at Wood's Holl. From the first, instruction has been encouraged as much as investigation, and in any year the number of students receiving instruction will far exceed those carrying on independent research. The Marine Biological Laboratory is for the diffusion as well as for the increase of knowledge, and the fact that it trains many of those who come to it for elementary instruction, to become, eventually, investigators, does not in the least invalidate its claim to be considered an institution for instruction.

In the editorial columns of the *Philadelphia Evening Bulletin*, of March 21st, appeared a quotation of remarks made by the Secretary of the Academy of Natural Sciences with reference to the Peary Relief Expedition. These remarks are to the effect that the Academy will not subscribe to the expedition which is to start shortly to bring Lieutenant Peary back from the Arctic regions; and the reason given is that the results obtained by the Peary Expeditions are not of sufficient scientific importance to warrant the Academy in making the subscription. As this is the second time within the last few months that persons in authority in that institution have expressed such sentiments regarding the Peary Expeditions, there is probably some truth in the statement that the Academy will not subscribe to this enterprise. It is to be hoped, however, that the real reason for this action is financial inability, rather than that which has been given by these self-constituted mouthpieces of the Academy. It should not be necessary to repeat, at this day the importance of such expeditions to science. There is no doubt that if the Academy can stand this kind of talk, Lieutenant Peary can-

RECENT LITERATURE.

Botany in the Secondary Schools.[1]—We have before us a most excellent guide to plant study, bearing the marks of faithful, conscientious effort from title page to finish. No one who has had experience in conducting courses in botany with college students will deny that a great deal of the instruction given in this science in secondary schools is loose, unscientific and crude to the last degree. Notwithstanding the recent attention given to this fact in scientific journals the evils have not yet by any means been entirely remedied. Indeed they frequently extend beyond the lower schools, even into the colleges and universities themselves.

The author of this Guide is well-known as a thoroughly successful botanical teacher of many years experience, and all the statements which he makes have been subjected to practical laboratory tests. Two things are to be especially guarded against in a manual of this kind: Telling the student too much, and giving too meagre assistance. In the latter case, either discouragement results or undue attention is paid to minor points while important matters are either entirely overlooked, or studied without reference to their proportionate significance. Some teachers in their eagerness to avoid the first blunder fall into the second which is even worse. Professor Spalding has, in most cases, satisfactorily avoided both errors.

The introduction contains timely suggestions to students and teachers, together with a well selected list of books of reference and laboratory material. We wish, however, to take emphatic exception to the statement that "in every case the pupil is to be provided with the material used." One of the principal objects in the study of any natural science should be to encourage the student to become acquainted with nature in its broadest sense, a knowledge to be obtained only by personal exploration in woods and fields. As has been previously pointed out in various journals the modern tendency of scientific study is to lose sight of the naturalist in the almost exclusive attention given to laboratory work. The benefit to be gained from the study of a flower or plant brought by the teacher to his classes is one-sided and very incomplete, and should by all means be supplemented by the personal investiga-

[1] Guide to the Study of Common Plants, an Introduction to Botany. Volney M. Spalding, Professor of Botany in the University of Michigan. Second edition, xxiii, 294 pp. Published by D. C. Heath & Co., Boston, 90 cents, postpaid.

tions of the students in its native habitat. As a matter of fact, however, the author does not adhere strictly to the advice above given but generally takes it for granted that the plant has also been observed while growing.

Chapters are given on seeds, germination, the root, stem, leaf, flower and fruit. Then the so-called flowerless plants are taken up, and the sea weeds and their allies, molds and rusts, mosses and liverworts, ferns and horsetails are studied. The conifers and leading families of monocotyledons and dicotyledons follow in their natural order.

Each chapter begins with a list of material needed for study, contains minute and practical directions to the student and closes with an admirable summary. Copious references to the literature of the subjects are given in foot notes. One of the most valuable features of the work are the numerous questions asked and the special topics for study which the author suggests under each group. Simple physiological experiments, such as any student working alone, or teacher even in our district schools can easily perform, are described. Such subjects as seed dispersion and protection, fertilization, assimilation, respiration, and transpiration, adaptation of various plant organs to their environment as well as plant relationships are treated in a fresh and interesting manner quite different from the ordinary laboratory guides.

When one considers the great diversity and looseness of terminology employed by many prominent botanical writers, the difficulty as well as the necessity is apparent of having accurate definitions and plant descriptions. The glossary at the close of Professor Spalding's Guide is most commendable, and constitutes one of the many admirable characters of work which we heartily commend to all lovers of plant life. Not only secondary schools, but also students working by themselves will find it exceedingly helpful. We know of nothing better adapted to the short winter courses given by some of our Agricultural Colleges, and for use in University Extension instruction.

GILBERT H. HICKS.

The New Check-List of Plants.[2]—The recent considerable changes in botanical nomenclature have made necessary such a book as the one here noticed. We have had in various monographs and scattered notes in botanical journals so many records of changes, and notices of others which should be made, that any one doing critical work has been compelled to make a catalogue for himself, or lose much time whenever he worked over a new lot of species. One does not have to subscribe to everything done by the committee to feel that the

work will be a useful one. Take a couple of cases from Papaveraceæ; all remember something of the discussion as to the proper generic name for the "Dutchman's Breeches," given in our manuals as *Dicentra*. Here we find that *Dicentra* was proposed by Bernhardi in 1833, and that he was anticipated by Borckhausen who published the name *Diclytra* in 1797, but who was himself preceded by Adanson who in 1763 first used the name *Bikukulla*, which in its corrected from *Bicuculla* is, therefore, the name we should cite in this instance.

Again we have the genus *Corydalis* in our manuals; but if we look up its history we find that this name was proposed by Ventenat in 1803; but Scopoli's name *Neckeria* precedes this by more than a quarter of a century (1777), while Adanson's name *Capnoides* is earlier still (1763).

We are becoming so democratic, even in science, that it is desirable that the reasons for changes and modifications should be laid before the public. Even the most obscure botanist is nowadays entitled to know why an old plant comes out under a new name. It may vulgarize science somewhat and take from it that element of the mysterious which it formerly possessed, if we lay these things before the world. When the world learns that the pronouncements of "Science" are after all only the judgments of, say, Professor Britton, Professor Coulter, Professor Scribner, or some other mortal, it may not stand in such ignorant, open-mouthed wonder as it formerly was wont to do. It may even cry out against them, and demand that the golden calf be set up again. But if these professors set forth plainly that their work is plain work, the plain and straightforward statement of facts, the world will eventually cease to be the blind idolaters of that which they do not understand.

This book is quite likely to be railed at by some people who are themselves botanists. In one respect it is a revolutionary work, or rather, it is the mark of a revolution, and in all revolutions there are some who fear the consequences. This book is the sign that the day of "authority" as such, is ended, and the day of "law" has begun. The day of botanical "equality before the law" has come, and the humblest botanist now may lawfully correct the greatest.

What, now, is this work? It includes the names of about 4350 species, each of which has been critically examined, and as far as pos-

[2] List of Pteridophyta and Spermatophyta growing without cultivation in Northeastern North America. Prepared by a committee of the Botanical Club, American Association for the Advancement of Science, 1893-1894. Price $3.00 (Memoirs of the Torrey Botanical Club, Vol. V.)

sible, its synonymy adjusted in accordance with the Paris Code of 1867, as interpreted by the botanists at Rochester in 1892 ("Rochester Rules"). Thus the point of beginning for generic and specific names is 1753, the date of the first edition of the *Species Plantarum* of Linnæus, and in all cases "priority of publication" has been regarded as of prime importance in the determination of the name to be employed. Thus we have here given that name for each plant which these botanical laws indicate, and in the list of synonyms we find the names which these same laws compel us to reject. The treatment may be better understood by a couple of examples, as follows:

1953. **Cleome serrulata** Pursh, Fl. Am. Sept. 441 (1814).
 Cleoma integrifolia T. & G., Fl. N. A. I: 122 (1838).

4303. **Taraxacum taraxacum** (L.). Karst. Deutsch. Fl. 1138 (1880–'83).
 Leontodon taraxacum L., Sp. Pl. 798 (1753).
 Taraxacum officinale Weber., Prim. Fl. Holst. 56 (1780).
 Taraxacum dens-leonis Desf., Fl. Atlant. 2: 228 (1800).

What more could be asked? The whole history of the species is here given so plainly that any one may verify each step for himself. That the work will be found to contain errors and omissions goes without saying. The committee did not expect to present a faultless work, but they did set before themselves the task of making an honest, plain list in which they record their findings, and for this the botanists of all sects and schools, in all parts of the world owe them a deep debt of gratitude.

CHARLES E. BESSEY.

Bulletin of the U. S. Fish Commission Vol. XII.[3]—This quarto volume contains eleven important papers on fishes of the United States, prepared by specialists, together with a report on the Oyster Industry of Maryland, by C. H. Stevenson. Much of the information imparted in these papers is new, and valuable either from an economic, or a purely scientific standpoint. All are splendidly illustrated with page plates, making in all 118 plates accompanying the text. The following table of contents shows the range of subjects treated.

Bean, T. H. Bibliography of the Salmon of Alaska and adjacent Regions.—Life History of the Salmon.—Eigenmann, C. H. On the

[3] Bulletin of the United States Fish Commission. Vol. XII for 1892. Washington, 1894.

Viviparous Fishes of the Pacific Coast of North America.—Evermann, B. W. Description of New Sucker (*Pantosteus jordanii*) from the Upper Missouri Basin.—Evermann, B. W. and W. C. Kendall; The Fishes of Texas and the Rio Grande Basin, considered with reference to their Geographic Distribution.—McDonald, M. Report on the Salmon Fisheries of Alaska.—Moore, H. F. List of Fishes collected at Sea Isle City during the Summer for 1892.—Rathbun, R. Summary of Fishery Investigations conducted in the North Pacific Ocean and Behring Sea from July 1, 1888 to July 1, 1892, by the U. S. Fish Commission Steamer *Albatross*.—Smith, H. M. The Fyke Nets and Fyke-Net Fisheries of the United States, with Notes on the Fyke Nets of Other Countries.—Economic and Natural-History Notes on Fishes of the Northern Coast of New Jersey.—Stevenson, C. H. The Oyster Industry of Maryland.—Ulrey, A. B. and C. H. Eigenmann; A Review of the Embiotocidæ.

Paleontology of Missouri, Part I.[4]—This memoir is a concise account of the fossil invertebrate fauna of Missouri prepared by the State Geologist, C. R. Keyes with reference to the distinct economic importance that organic remains have in determining the age of rocks and hence aiding to develop the mineral wealth of the state. Following the introductory chapter is a brief sketch of the stratigraphy of the state and an explanation of the biological relations of fossils. The remaining pages are devoted to descriptions of the invertebrate fossils of the state which have passed under the personal observation of the author.

For illustration the leading Missouri species of each genus has been figured, and also some forms heretofore described but not figured, making in all 20 plates. In addition many typical exposures of rocks are well represented.

[4] Missouri Geological Survey Vol. IV. Paleontology of Missouri, Part I. By Charles R. Keyes.

RECENT BOOKS AND PAMPHLETS.

Agriculture of Pennsylvania. Containing Reports for 1893 of the State Board of Agric., State Agric. Soc., State Dairyman's Assoc., State Horticul. Soc., and the State College. From Thos. J. Edge.

Annual Reports of the Academy of Natural Sciences of Philadelphia for 1893.

Annual Report of the Arkansas Geological Survey, Vol. II, 1894.

Annual Report of the Yorkshire Society for 1893.

BAILEY, L. H.—A Paper on Electricity and Plant-Growing. Extr. Trans. Mass. Horticul. Soc., 1894.

BARBER, H. G.—A List of Nebraska Butterflies. Extr. Proceeds. Nebr. Acad. Sci., IV, 1894. From the author.

BARBOUR, E. H.—Additional Notes on the New Fossil, Dæmonelix. Its Mode of Occurrence, Its Gross and Minute Structure. Extr. Univ. Studies, Vol. II, 1894. From the author.

BEAN, T. H.—The Fossils of Pennsylvania. Harrisburg, 1893. From the author.

BEECHER, C. E.—On the mode of occurrence, and the structure and development of *Triarthrus becki*. Extr. Am. Geol., 1894.——The Appendages of the Pygidum of Triarthrus. Extr. Am. Journ. Sci., Vol. XLVII, 1894. From the author.

Biennial Report of the Alabama Bryce Insane Hospital for 1893 and 1894.

Book of the Tariff as prepared by the U. S. Senate of 1893–94.

Bulletin of the United States Fish Commission, Vol. XII, for 1892. Washington, 1894.

BUTLER, A. W.—The range of the Crossbill in the Ohio Valley, with notes on their unusual occurrence in Summer. Extr. Proceeds. Brookville Academy, 1892. From the author.

CHENEY, E. P.—Translations and Reprints from Original Sources of European History. The Early Reformation Period in England. Wolsey, Henry VIII, and Sir Thomas More. Philadelphia, 1894. From the author.

DAWSON, G. M.—The Progress and Trend of Scientific Investigation in Canada. Extr. Trans. Roy. Soc. Canada, 1894. From the author.

EIGENMANN, C. H.—Results of Explorations in Western Canada and the Northwestern United States. Extr. Bull. U. S. Fish Commission for 1894. From the author.

EYERMAN, J.—On a Collection of Tertiary Mammals from southern France and Italy, with brief descriptions thereof. Extr. Am. Geol., Vol. XII, 1893. From the author.

Geological Map of Alabama, with Explanatory Chart. Montgomery, 1894. From Eugene A. Smith.

HOBBS W. H.—On a Recent Diamond Find in Wisconsin, and on the probable Source of this and other Wisconsin Diamonds. Extr. Amer. Geol., Vol. XIV, 1894. From the author.

HOLMES, W. H.—An Ancient Quarry in Indian Territory. Published by the Bureau Ethnology of the Smithsonian Institution, 1894. From the Smithsonian Institution.

HORN, G. H.—The Coleoptera of Baja, California. Extr. Proceeds. Cal. Acad. Sci., Vol. IV, 1894. From the author.

JUNGERSEN, H. F. E—Die Embryonalniere von *Amia calva.* Separat-Abdruck aus dem Zool. Anz., 1894. From the author.

KEYSER, L. S.—In Bird-Land. Chicago, 1894. From the Pub., A. C. McClurg & Co.

KEYES, C. R.—Paleontology of Missouri (Part I). Missouri Geol. Surv. Vol. IV, 1894. From the author.

LAMBORN, R. H.—Some Italian "Survivals."—A "Longhouse" in the Tiber Delta. Extr. Science, March, 1894. From the author.

LAWSON, A. G.—The Geomorphegeny of the Coast of Northern California. Extr. Bull. Univ. Cal., Vol. I, 1894. From the University.

MASON, O. T—Woman's Share in Primitive Culture. New York, 1894. From the author.

MILLER, G. S.—On a collection of small Mammals from the New Hampshire Mountains. Extr. Proceeds. Bost. Soc. Nat. Hist., Vol. XXVI, 1894. From the author.

MURRAY, AARON E.—The Butterfly Hunters in the Caribbees. New York, 1894. From the Pub., Charles Scribner's Sons.

OWEN, REV. O.—The Life of Richard Owen. Vols. I and II. New York, 1894. From the Pub., D. Appleton & Co.

Proceedings of the International Congress at Zurich, 1894. From Dr. P. Frazer.

RYDER, J. A.—Dynamical Evolution. A Lecture delivered at the Marine Laboratory at Woods Holl. Boston, 1894. From the author.

SALMON, D. E.—Investigations Concerning Bovine Tuberculosis, with Special Reference to Diagnosis and Prevention. Bull. No. 7, 1894, U. S. Dept. Agric., Bureau Animal Industry.

SCHUCHERT, C.—A Revised Classification of the Spire-Bearing Brachipods and Spire-Bearing Genera of the Paleozoic Brachipoda. Extr. Am. Geol., Vol. XIII, 1894. From the author.

SEELEY, H. G.—On *Euskelesaurus brownii* Huxley. Extr. Am. Mag. Nat. Hist., Vol. XIV, 1894. From the author.

SMITH, E. A., L. C. JOHNSON, AND D. W. LANGDON, JR.—Report on the Costal Plain of Alabama, with Contributions to its Paleontology by T. H. Aldrich and K. M. Cunningham. Montgomery, Alabama, 1894. From E. A. Smith.

SPENCER, J. W.—The Duration of Niagara Falls. Extr. Am. Journ. Sci., Vol. XLVIII, 1894.

Review of McGee's Lafayette Formation. Twelfth Ann. Rept. U. S. Geol. Surv. From the author.

SUESS, M. E.—Beiträge zur Stratigraphie Centralasiens. Extr. Sitzung der Math-natur. Classe Kaiserliche Akad. der Wissenschaften in Wien, 1894. From the author.

Thirteenth Annual Report of the United States Geological Survey to the Secretary of the Interior, 1891–92, by J. W. Powell. Part II, Geology ; Part III, Irrigation. From the Geol. Survey.

TOPINARD, P.—Quelques conclusions et applications de l'Anthropologie. L'homme Animal. L'homme social. Extr. de L'Anthropologie, Vol. IV, 1893. From the author.

VARIGNY, H. DE.—Recherches sur le Nauism Experimental. Contributions à l' étude de l' influence du milieu sur les organismes. Extr. Journ. L'Anatomie et de la Physiologie, 1894. From the author.

WALCOTT, C. D.—Note on some Appendages of the Trilobites. Extr. Proceeds. Biol. Soc. Washington, 1894. From the author.

WILLIAMS, E. H.—Extramorainic Drift between the Delaware and the Schuylkill. Extr. Bull. Geol. Soc. Am. Vol. V, 1894. From the Society.

WINSLOW, A.—The Coal Measures of Missouri. Extr. Min. Resources U. S., 1892. Washington, 1893.——Geological Surveys in Missouri.——Notes on the Lead and Zinc Deposits of the Mississippi Valley and the Origin of the Ores. Extr. Journ. Geol. No date given. From the author.

General Notes.

GEOGRAPHY AND TRAVELS.

Where is the greatest forest in the world ?—The question was asked in the Forestry section of the American Association for the Advancement of Science, at its last annual meeting. The importance of forests for equalizing the climate and the rainfall of the globe was under discussion, and the purpose of the question was to show where the great forest tracts of the world are situated.

One member replying off hand, was inclined to maintain that the greatest continuous tract of forest lies north of the St. Lawrence River, in the provinces of Quebec and Ontario, extending northward to Hudson Bay and Labrador; a region measuring about 1,700 miles in length from east to west, and 1,000 miles in width north and south.

A professor from the Smithsonian Institution rejoined that a much larger continuous area of timber lands was to be found, reckoning from those in the State of Washington northward through British Columbia and Alaska. But he limited his statement to North America, for he added that, in his opinion, the largest forest in the world occupied the valley of the Amazon, embracing much of northern Brazil, eastern Peru, Bolivia, Ecuador, Colombia, and Guiana; a region at least 2,100 miles in length by 1,300 in breadth.

Exception was immediately taken to this statement by several members who, in the light of recent explorations, have computed the forest area of Central Africa in the valley of the Congo, including the head waters of the Nile to the northeast, and those of Zambesi on the south. According to their estimates, Central Africa contains a forest region not less than 3,000 miles in length from north to south, and of vast, although not fully known width, from east to west. Discussion, in which the evidence afforded by travels and surveys was freely cited, seemed favorable to the defender of the Amazonian forests.

Later in the day the entire question was placed in another light by a member who was so fortunate as to be able to speak from some knowledge of still another great forest region of the globe. This gentleman gave a vivid picture of the vast, solemn taigas and urmans, the pine, larch and cedar forests of Siberia.

It appears that Siberia, from the plain of the Obi River on the west to the valley of the Indighirka on the east, embracing the great plains,

or river valleys, of the Yenisei, Olenek, Lena and Yana rivers, is one great timber belt, averaging more than 1,000 miles in breadth from north to south—being fully 1,700 miles wide in the Yenisei district—and having a length from east to west of not less than 4,600 versts, about 3,000 miles. Unlike equatorial forests, the trees of the Siberian taigas are mainly conifers, comprising pines of several varieties, firs and larches. In the Yenisei, Lena and Olensk regions there are thousands of square miles where no human being has ever been. The long-stemmed conifers rise to a height of 150 feet or more and stand so closely together that walking among them is difficult.

The dense, lofty tops exclude the pale Arctic sunshine, and the straight, pale trunks, all looking exactly alike, so bewild the obscurity that all sense of direction is lost. Even the most experienced trappers of sable dare not venture into the dense taigas without taking the precaution of "blazing" the trees constantly with hatchets as they walk forward. If lost there the hunter rarely finds his way out, but perishes miserably from starvation or cold. The natives avoid the taigas, and have a name for them which signifies "places where the mind is lost."

The discussion closed very appropriately by Prof. Fernow, of Washington, with an illustrated lecture, which showed how in the earlier ages forests had covered all the continental areas, and had rendered the climate equable to a degree now unknown.

At first human beings battled with the forest in a fitful manner, making small clearings for themselves; but, gradually, by the aid of fire, and of their own increasing numbers, they have so far prevailed in the struggle for supremacy that the forests are hopelessly conquered. But grave evils follow their extermination; and now the question is how to foster, protect and preserve them. (Quoted from Youth's Companion, Scientific American, March, 1895.)

MINERALOGY.[1]

Symmetry of Nepheline and Davyne.—Baumhauer's studies of the etched figures of nepheline produced by hydrofluoric and hydrochloric acids, have shown that the mineral belongs in that division of the hexagonal system in which trapezohedral or pyramidal hemihedrism is combined with hemimorphism—the first hemimorphic tetartohedrism of Liebisch—and that apparently simple individuals are usually compound twins, the twinning planes being the base and the second order prism. As more recent studies of Tenne seemed to lead to a different conclusion, Traube[2] has repeated Baumhauer's studies on excellent material from Vesuvius, with the result of confirming the latter in every particular. He has also obtained excellent figures on the prism planes by use of concentrated or warm dilute hydrochloric acid, the figures having the same symmetry but not the same form as those produced by hydrofluoric acid. He has observed one twinning law in addition to the two described by Baumhauer. The examination of a twinned section 5 mm. in thickness cut normal to the principal axis gave no evidence of circular polarization. He has investigated for the first time the etched figures of the closely related mineral Davyne, which may be easily etched with nitric acid. On the prism planes these figures possess two lines of symmetry, normal to one another, showing that the mineral is holohedral hexagonal. As nepheline is not attacked by nitric acid this affords a ready means of distinguishing the two minerals from one another. It is especially valuable because Traube finds that Davyne is not always optically positive as has been supposed.

The Minerals of the Emery Deposits of Naxos.—Except for a paper by Smith on the paragenesis of these deposits and one by Zirkel on the two chief minerals (corundum and magnetite), no scientific mineralogical study of the deposits has heretofore been made. Tschermak[3] contributes to the *Mittheilungen* the results of a detailed study of a large number of specimens from the locality. The island of Naxos is composed of fine grained gneisses and marbles resting on a basement of coarse grained gneisses. The emery occurs in numerous

[1] Edited by Dr. Wm. H. Hobbs, University of Wisconsin, Madison, Wis.

[2] Neues Jahrb. f. Min. etc., Beil. Bd. ix, pp. 466–479, 1894.

[3] Min. u. petrog. Mittheil., xiv, pp. 311–342, 1894.

lenticular masses of great extent and having a thickness of 5 to 50 meters, enclosed in the granular limestone. It is chiefly a mixture of corundum and magnetite with hematite and limonite as alteration products. The only accessory mineral usually apparent to the naked eye is margarite, but Tschermak shows that there are often present in small quantities both the common micas, chlorotoid, Vesuvianite, diaspore, kyanite, staurolite, rutile, spinel, and pyrite. Thin sections were prepared and detailed descriptions are furnished of the optical properties of the different constituents. The corundum is part crystallized and part in grains. The crystals show zonal distribution of the pigment and optical anomalies, and are frequently filled with magnetite and rutile inclusions. The margarite yields in lath-shaped sections a positive bisetrix with axial plane normal to the cleavage. Basal sections afford a negative bisectrix with small optical angle. The double refraction is lower than that of muscovite. The structure of the emery is quite schistose, due chiefly to the distribution of the magnetite grains which form layers of variable thickness. Tschermak thinks that the original condition was a compact and homogeneous mass, and that the accessory minerals were separated out when the corundum and magnetite were crystallized. Analyses of the emery from Kremnó and Renidi were made by Ludwig with the following results:

Kremnó.

SiO_2 5.64, B_2O_3 1.15, Al_2O_3 57.67, Fe_2O_3 33.36, MgO 0.83, CaO 0.43, K_2O 0.31, Loss on ignition, 0.70, Total 100.09.

Renidi.

SiO_2 5.45, B_2O_3 0.88, Al_2O_3 56.52, Fe_2O_3 34.65, MgO 0.43, CaO 0.90, Na_2O 0.60, K_2O 0.40, Loss on ignition 0.42, Total 100.25.

A lengthy detailed description of specimens of emery from the different localities closes the paper.

Boleite and Cumengeite.—In a separate publication Cumenge[4] has given a more complete description than has heretofore been made of the interesting minerals Boleite and Cumengeite, which were recently found in the copper mining district of Boleo in Lower California. *Boleite* occurs in apparently cubic crystals of a deep indigo blue color in an argillaceous gangue locally known as *Jaboncillo*. They

[4] Note sur deux espèces minérales nouvelles la Boléite et la Cumengéite, par M. E. Cumenge, Paris, 1893.

fuse readily in a candle flame, have a hardness of 3, and a specific gravity of 5.08. The index of refraction is very high, approximately 2.07. The composition of the mineral is expressed in the formula $PbCl_2+CuOH_2O+\frac{1}{3}AgCl$ or as it was written by Mallard, 3 { PCbl (HO). CuCl(HO) { +AgCl. The crystals are apparently cubes which are sometimes truncated by the octahedron or the dodecahedron. Cleavage is perfect parallel to (100) and less perfect parallel to (111). The optical properties show clearly that the apparent cubic form is caused by the twinning of three tetragonal individuals so that their axes are all normal to one another.

Cumengeite is much like Boleite but occurs in pyramidal crystals, is more violet in tone, and has hardness and specific gravity somewhat inferior to those of Boleite. Chemically it differs from that mineral in the absence of $\frac{1}{3}AgCl$, the formula being given as PbC2 (Index) $+CuOH_2O$. The symmetry is tetragonal, the crystals being usually bounded by á (011) and m (110) and rarely also by p (001). In connection with the simple individuals of Boleite and Cumengeite are found very interesting twinned individuals which usually give the appearance which would result from attaching by its square face to each of the six faces of a cube the half of a symmetrically developed octahedron. The face of this particular pyramid (*l*) has not been observed on any of the individuals of either mineral. Sometimes the solid angles of the projecting pyramids formed by *l* are symmetrically truncated, so that an apparent cube with reentrant or grooved edges is the result. The composition of these interesting trillings has not been fully determined, but they are found to be intermediate between Boleite and Cumengeite in their content of silver. Mallard has applied to them the name Percylite which had before been used for an undetermined cubic mineral of somewhat allied characters. Friedel has succeeded in producing artificial crystals of both Boleite and Cumengeite by the action of copper chloride on lead hydrate.

The Formula of Pseudobrookite.—The chemical composition of pseudobrookite has been determined by Cedarström on material from Havredal in Norway and by Rimbach on selected material from the Aranyerberg in Siebenbürgen, to be represented by the formula $2Fe_2O_3$ $3TiO_2$, the two analyses agreeing very closely. The analysis of an artificial pseudobrookite from Schönebeck on the Elbe yielded Doss the formula Fe_2O_3 TiO_2, and led the analyst to suppose that the mineral is isomorphous with andalusite. Frenzel[5] has undertaken an analysis of the material from the Aranyerberg and obtained results

[5] Min. u. petrog. Mittheil., xiv, pp. 126–130, 1894.

which agree perfectly with those of Cedarström and Rimbach. Traube has contributed to the same paper the almost identical results of an analysis of the same material, so that there can be little doubt that $2Fe_2O_3\ 3TiO_2$ is the correct formula of the mineral. Frenzel points out the absurdity of the supposed isomorphous relation with andalusite. Neglecting the earlier analyses by Koch and by Lattermann on imperfectly purified material, the analyses that have been made of pseudobrookite are as follows:

	I	II	III	IV	V	VI
TiO_2	44.26	42.49	33.59	42.89	42.35	42.896
Fe_2O_3	56.42	58.20	66.42	56.37	57.65	57.104
Total	100.68	100.69	100.01	99.26	100.00	100.000

I. Cedarström, II. Rimbach, III. Doss, IV. Frenzel, V. Traube, VI. theory from formula $2Fe_2O_3\ 3TiO_2$.

Formula of Staurolite.—Rammelsberg[6] takes exception to the formula for staurolite recently proposed by Penfield[7] ($HAl_5Fe\ Si_2O_{13}$). He claims that the analyses of staurolite show the mineral to represent chemically three varieties, as follows:— A, where $\overset{II}{R} : R_2 = 1:2$; B, where $\overset{II}{R} : R_2 = 1:2.5$; and C, where $\overset{II}{R} : R_2 = 1:3$. Penfield's formula, he states, is not a general one because it only represents the analyses which fall in group B.

[6] Neues Jahrb. f. Mineral., etc. Beil. Bd., ix, pp. 480–484, 1894.
[7] Am. Jour. Sci., (3) xlvii, pp. 81–89, 1894.

Wm. H. Hobbs.

PETROGRAPHY.[1]

Some Basalts of Asia Minor.—The rocks near Kula, Asia Minor, are basalts in sheets and lava streams, the latter emanating from a number of old volcanic centers whose cores may still be distinguished. These basalts, according to Washington,[2] are hornblende-plagioclase basalts, characterized especially by the abundance of their hornblendic component. This mineral, augite and olivine are present as phenocrysts in a groundmass made up of plagioclase, magnetite and glass, the latter being lighter in color as the magnetite in it increases in quantity, thus indicating that this mineral was one of the latest separations from the magma. Leucite was discovered in two of the streams. It presents no unusual features. The mineral is rare in hornblendic basalts elsewhere. None of the components of the rocks merit special mention but the hornblende. This is always porphyritic and is present in large quantity. Its color is yellow, brown or greenish-yellow, and its extinction varies from 4° to 23°. The chemical alterations effected in the mineral by magmatic resorption are interesting. One effect is the replacement of the hornblende by a reddish-brown mineral associated with colorless augite and opacite, and another is its partial or complete alteration into augite and opacite. The brown mineral is referred to hypersthene, although the analysis of a portion of the rock containing a large quantity of it was rather against this theory. The author thinks that the formation of the mineral was probably due to the reducing action of hydrogen (from dissociated water included in the lava) upon the ferric iron of the hornblende. In structure the basalts are normal, hyalopilitic, semi-vitreous and tachylitic. An analysis of a leucite variety gave:

SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	Na_2O	K_2O	P_2O_5	H_2O	Total
47.74	20.95	3.29	6.32	7.56	5.16	7.12	1.21	.13	.04	= 99.52

Since the hornblende is of primary importance in the basalts of Kula, it is proposed to call them, and other basalts in which hornblende predominates over augite and olivine, by the name of Kulaites.

The Igneous Rocks of the Eureka District.—In an appendix to the Geology of the Eureka District, Iddings[3] gives an account of

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Maine.

[2] Amer. Jour. Sci., Feb., 1894, p. 114.

[3] Monograph XX U. S. Geol. Survey, p. 337.

the igneous rocks of the region with special reference to the lavas whose studies led Hague to the proposal of the theory that the various types of rocks in the Eureka district are differentiated portions of one magma, which split up into two, one yielding feldspathic acid rocks and the other pyroxene basic ones. Among the intrusive rocks of the region Iddings mentions only granites, granite-porphyries and quartz-porphyries. The volcanic rocks include hornblende-andesite, hornblende-mica-andesite, dacite and rhyolite, which are the types derived from the more acid portion of the original magma, and pyroxene-andesites and basalts derived from the basic portion. The pyroxene-andesite contains anorthite, hypersthene, augite, hornblende, a little biotite and an occasional quartz grain, in a glassy groundmass with a felt-like structure produced by labradorite and augite-microlites. The hornblende-mica-andesites are more acid. They contain labradorite, hornblende, biotite and a little quartz as porphyritic crystals in a micro-crystalline groundmass of lath-shaped plagioclases and intergrowths of feldspar and quartz. The dacites are rare. They possess macroscopic quartz-phenocrysts together with hornblende, hypersthene, a little augite, biotite, labradorite, anorthite, and possibly orthoclase in a pumiceous glass base, which also often contains many beautifully crystallized zircons. The rhyolites met with present few characters of special interest. They vary in the texture of their groundmass from micro-crystalline to glassy varieties. Their sanidine phenocrysts have the plane of their optical axes sometimes in the plane of symmetry and sometimes perpendicular thereto. Occasionally the rock possesses also phenocrysts of hypersthene. The basalts are poor in olivine, and this mineral when present is often changed into serpentine or into the reddish-brown substance to which Lawson has given the name iddingsite. Hypersthene is present in some of the sections, and in others are a few grains of quartz surrounded by augite borders.

Notes from Minnesota.—In a preliminary report of a season's field work in northeastern Minnesota, Elftman[4] refers to the gabbro of the region as producing contact metamorphism in the slates and schists to the north of it. He describes more particularly the actinolite-magnetite slates, from near Birch Lake, that are believed to have originated in a fragmental rock whose nature, however, is not fully set forth. The gabbro is an olivinitic variety. In it are great masses of anorthosite regarded by the author as phases of the gabbro. This is the rock

[4] 22d Ann. Rep. Geol. & Nat. Hist. Survey of Minn., p. 141.

which was reported by Lawson[5] as representing an old basement lying unconformable beneath the gabbro.

The Geology of Dartmoor, England.—McMahon[6] gives a few brief descriptive notes on some trachytes, felsites, mica-diorites, dolerites, tuffs and hornblende-schists from the western flank of Dartmoor. The trachytes and felsites are more or less altered, and the tuffs always very much so. The tuffs contain fragments of several kinds of lavas and of altered sedimentary rocks. The cementing material is "like the microgranular base of some rhyolites and porphyries." The most interesting rocks are the hornblende schists, which are thought by the author to be altered basic tuffs. They are marked by a fine grained parallelism of their constituents, producing a structure which the author designates the "corduroy structure." The rocks consist of augite, secondary hornblende and feldspar, the first two of which are often well crystallized. Their alteration is thought to be due to the intrusion of the tuffs by the great mass of epidiorite of the Cock's Tor. The basic schists of the Lizards that have been so repeatedly discussed, are believed to have had a similar origin.

Miscellaneous Notes.—The study of a series of nepheline rocks leads Gentil[7] to the conclusion that the peg structure so characteristic of this mineral is an effect of alteration. The alteration product is often a hydrated pleochroic substance with a yellowish tinge. The 'pegs' are produced by the extension of this substance along directions of feeble cohension in the original mineral (solution planes ?)

The rock by whose decomposition the apophyllite[8] of Callo in Algeria was formed, is a biotite-augite-andesite, whose groundmass is usually more altered than the phenocrysts. The inclusions found in the rock are of cordierite gneiss, fragments of andalusite and of sillimanite and large segregations of plagioclase a little more basic than the feldspar of the phenocrysts.

On account of the similarity in crystalline structure between flint and Arkansas whetstone, Rutley[9] is inclined to regard the latter rock as derived by the replacement of limestone or dolomite by silica. The rhombohedral cavities noted by Griswold are thought to have been

[5] Bull. No. 8, Geol. & Nat. Hist. Survey of Minn.

[6] Quart. Jour. Geol. Soc., 1894, p. 338.

[7] Bull. Soc. Franc. d. Min., xvii, p. 108.

[8] Ib., p. 11.

[9] Quart. Jour. Geol. Soc., 1894, p. 377.

produced by the solution of some crystals of calcite or dolomite that remained for a time in the midst of the replacing silica after all the rest of the carbonate had been removed.

Pearce[10] gives a series of analyses to sustain his theory that the free gold of the Cripple Creek District, Colorado, has been mainly derived from the oxidation of tellurides.

In a preliminary report on the Rainy Lake Gold Region in Minnesota and Manitoba, H. V. Winchell and U. S. Grant[11] give some brief notes descriptive of the Laurentian, Coutchiching and Keewatin rocks of the district.

[10] Colo. Scient. Soc., April 5, 1894.

[11] 23d Geol. & Nat. Hist. Sur. of Minn., p. 36.

GEOLOGY AND PALEONTOLOGY.

Origin of the Continental Area of Australia.—The following account of the probable origin of the Australian Continent is given by Professor David in a presidential address before the Linnean Society of New South Wales:

"That the movements of the earth's crust which laid the foundations of the Australian Continent commenced in Pre-Cambrian time is conclusively proved by the vast amount of folding to which the Archean rocks at Androssan and in the Mount Macdonnell Ranges were subjected before the deposition of the earliest Cambrian sediments.

"In Tasmania the crumpling of the crust took place between E. N. E. and W. S. W. directions, so that the axes of the fold trend N. N. W. and S. S. E.

"At St. Vincent's Gulf, near Adelaide, the folds run chiefly N. E. and S. W., and N. N. E. and S. S. W., so as to meet, if produced, a prolongation of the Tasmanian axes toward the N. W., nearly at right angles. In the Macdonnell and Musgrave Ranges, the trend is E. and W., and in the Kimberly District of West Australia, N. W. and S. E., with a secondary folding S. W. and N. E.

"It is not certain whether, either in Australia or Tasmania, there was any land surface in Archean time, but the conglomerates in the Archean and in the succeeding Cambrian, and the ripple-marked flaggy quartzites (if they are Archean or Cambrian and not Lower Silurian) imply shallow seas, with probably a neighboring land surface. It is improbable, too, that the Archean strata should have been as powerfully folded, as observation shows them to have been, in Pre-Cambrian time, without some areas being elevated sufficiently to form land.

"In Australia, therefore, there was probably land and probably contemporaneous life, at all events, in the seas, in Pre-Cambrian time, the latter assumption being rendered probable by the occurrence of the beds of limestone and contemporaneous (?) iron-ores and graphite in the Archean rocks of South Australia, and of limestone and contemporaneous (?) ironstone in the Archean rocks of Tasmania, and also by the great diversity of forms of animal life met with in the succeeding Lower Cambrian rocks.

"The earliest known folding of the Australian region took place in Pre-Cambrian time in Australia and Tasmania, and, at least, as far

back as Pre-Silurian time in New Zealand. In Victoria, South Australia and Tasmania, the original lines of folding along the Tasmanian and Adelaide axes continued to be developed all through the Cambrian, Silurian and part of Devonian time, and along the Tasmanian axis during a portion, at least, of the Carboniferous Period. The Kosciusko axis, however, would appear to be of somewhat later origin than the Tasmanian and Adelaide and New Zealand axes. Possibly, an extension northwards of the Kosciusko axis in Carboniferous time reclaimed for the Australian Continent an area in New England, part of which had formed the floor of an ocean of moderate depth.

"At least five important foldings have taken place in the Australasian region between Pre-Cambrian and Carboniferous time inclusive, and each has had an important influence on the evolution of the continental area of Australia, but the last extensive folding, that of the Gympie, which took place in Carboniferous time, has been the chief factor in the evolution of the Main Dividing Range of Eastern Australia in the northern portion of New South Wales and in the greater part of Queensland.

"The folding along the New Zealand axis which commenced in Pre-Silurian time, was continued up to the close of the Mesozoic Era." (Proceeds. Linn. Soc. N. S. W., 2d Series, Vol. VIII, 1894.)

The Carboniferous System of Brazil.—In view of the recent discussions of correlation of the Upper Carboniferous formations of Brazil, Professor Derby has published a description of material collected from Amazonian localities. The list includes 122 species from Upper Carboniferous strata. The descriptions are prefaced with remarks on the geology of the localities in which this fauna is represented, and a comparison between the fauna of Lower Amazons and that of Southern Brazil is given as follows:

"Although there is, on the Lower Amazons, a considerable thickness, probably from 1000 to 2000 feet, of supposed Upper Carboniferous rocks, all the known fossils are marine and form a single, or two closely related horizons. As stated in my paper on the Brachiopods, the Andean Carboniferous fauna is about of the same horizon. In southern Brazil, where there is an extensive Carboniferous area, freshwater conditions seem to have prevailed and marine fossils have thus far proved to be rare and unsatisfactory. So far as their characters have been made out, they agree with the prevailing vegetable and reptilian types in presenting a decided Permian, or, perhaps, early Secondary facies. Both in its physical and in its paleontological

characteristics this formation of southern Brazil offers considerable analogies with those of South Africa, India, and Australia, containing the Glossopteris flora (see Waagen, Neues Jahrbuch, 1888, II, pp. 172–177). If, on further study, this analogy is found to hold good, we shall have at, or near, the close of the Paleozoic, two strongly contrasted chains of similar formations extending from east to west across the whole present land area of the globe. The one with an abundant and characteristic marine fauna reaches from China to Bolivia with the Salt Range and the Lower Amazons (also the Pichis River locality in Peru) as intermediate links; the other, with predominant freshwater and terrestrial conditions, reaches from Australia through India and Africa to southern central South America." (Journ. Geol., Vol. II, 1894.)

The Affinities of Agriochaerus.—In determining the relationship of Agriochaerus to the Oreodontidae, Dr. Scott briefly recapitulates the resemblances and differences of the two families, and gives, as a conclusion, that Agriochaerus is the last term in a succession of species which form a curiously specialized offshoot of the Oreodontidae, its divergencies from that family being principally the results of a change in the functions and uses of the feet. The separation of the two series was probably already established in the Uinta Eocene, for, in spite of its somewhat intermediate character, Protoreodon can be a forerunner only of the oreodonts. The Bridger beds may be expected to yield the common ancestor of the two series, and this animal will probably turn out to be a pentadactyl form, with buno-selenodont dentition and quinquetuberculate upper molars, the unpaired lobe in the anterior half of the crown. (Proceeds. Amer. Philos. Soc., Vol. XXXIII, 1894.)

The Mastodons of Russia.—The conclusions reached by Mme. Marie Pavlov in her study of the Mastodons of Russia and their relations to the Mastodons of other regions, are as follows:

(1) It is the group of *Mastodon* called *Zygolophodon* represented by *M. borsonii*, *M. americanus*, and their varieties, which had a very great distribution in southwest Russia during the Miocene and Pliocene periods.

(2) None of these forms is specific to Russia, all having been widely spread in West Europe and North America.

(3) The group of *Mastodon* called *Bunolophodon* is known only till now through a very limited number of specimens of *M. arvernensis*,

while this group is widely represented in West Europe, Asia and America.

(4) The close resemblance between the Mastodons of Eur-Asia and America confirms once more the connection which exists between the two continents during the Tertiary period. (Bull. Soc. des Naturl. Moscou, 1894, No. 2.)

Geological News.—Paleozoic.—In a paper on the Potsdam and calciferous formations of Quebec and Eastern Ontario, Mr. R. W. Ells submits evidence to show that the real line of division between the Cambrian and Cambro-Silurian systems should be placed at the close of the Georgia slate and red sandrock divisions, and that the series from the base of the typical Potsdam sandstone to the summit of the Utica and Hudson River formations should constitute the system known as the Cambrian-Silurian or Ordovician, in view of the fact that there is no stratigraphical break in the sequence of these formations, nor any want of harmony in the succession of organic life as furnished by the evidence of the contained fossils. (Trans. Roy. Soc. Canada, Section IV, 1894.)

The report on the Insect Fauna of the Rhode Island Coal Field, by Dr. Scudder, is published as Bulletin No. 101 of the U. S. Geol. Survey. The collection is an unusually interesting one, as all the species, without exception, are new to science and unknown elsewhere. They consist of Anthracomartus, the first discovered Arachnid in the Carboniferous deposits in the eastern United States; a new genus of Neuropteroidea and one of Protophasmida allied to some from the Carboniferous beds of Commentry, in France; and a number of cockroaches, represented only by their wings. These last show great variety of form. The two subfamilies of Palaeoblattariae are represented by three genera, including nearly a dozen species.

Mesozoic.—Various offices have been attributed to the Aptychus, but the recent discovery of an Ammonite (*Oppelia subradiata* Sow.), from Dundry, now in the British Museum, with the Aptychus *in situ* closing the orifice, would seem to disclose the true nature of that body, viz., that of an operculum. In view of this fact, Professor E. H. L. Schwarz shows how all the theories against its use as an operculum can be met with equally plausible ones in favor of that view, and throws the weight of his opinion in favor of such use. (Geol. Mag., Oct., 1894.)

A large Clypeastrid is reported from the Cretaceous formation near Colorado Springs, Colorado. Upon examination, Mr. F. W. Cragin

pronounces it not only the type of a new species, but a new genus also, which he calls Scutellaster. He believes that this genus may be regarded as a synthetic or generalized type from which have been evolved *Scutella* on the one hand and *Clypeaster* on the other. (Am. Geol., Feb., 1895.)

Recent collections from the Cretaceous Formation on Long Island have yielded forty-six additions to the previously recognized cretaceous flora of that region, nine of which are new species. They are described and figured by Mr. Hollick. (Bull. Torrey Bot. Club, Vol. 21, 1894.)

The presence of silicified paleozoic fossils in the Long Island gravel at Lloyd's Neck, and in the vicinity of Glen Cove, establishes its identity, in Mr. Hollick's opinion, with the "yellow gravel" of New Jersey. The author is inclined to refer some of the gravels on Martha's Vineyard to the same horizon. In the same paper the author discusses the Cretaceous clays of Long Island, and in view of the evidence of the fossil flora he correlates them wiih the Amboy clays of New Jersey, the Dakota group of the west, and the Lower Atane beds of Greenland. (Trans. N. Y. Acad. Sci., XIII, 1894.)

BOTANY.[1]

Nitrogen Fixation in Algæ.—The following results of research on this subject since 1892 are thus summarily stated in a recent number of Nature. They are chiefly derived from the papers of Grossowitsch, Schloessing, Laurent and Koch. Their observations shed much light upon the question of the relations exisiting between Algæ, microorganisms, and atmospheric nitrogen. They show:—

(1) That at least two Algæ—Cystococcus and Stichococcus—possess no "fixing" powers in themselves.

(2) That many Algæ, taken together with certain microörganisms of the soil, do possess the power of assimilating atmospheric nitrogen.

(3) That this power is much increased by the addition of such organic substances as sugar.

It should be noticed that among the ten cultures used in the second set of experiments, only two contained definitely isolated algal species, viz. the cases of the two cultures of Cystococcus and soil-bacteria.

It was just in this instance, moreover, that it had been shown that the Alga itself had no capacity for fixing atmospheric nitrogen. Accordingly there could be little doubt that it was through the agency of the microörganisms that the "fixation" had taken place in these latter cultures.

The experiments of Laurent and Schloesing had shown that if in a culture of Algæ and bacteria endowed with "fixing" powers, the Algæ were destroyed, the bacteria lost partly, if not entirely, this capacity, which the mixture had possessed. This pointed clearly to the fact that there was some close relationship existing between the Algæ and microorganisms.

There are many facts which seem to indicate the nature of this relationship.

Berthelot found that the nitrification of the soil only took place as long as organic compounds were present; if these were exhausted, the nitrifying process ceased. Gautier and Dronin also showed the importance which organic compounds have with respect to nitrification. Kossowitsch's own experiments, in which the advantage of adding sugar to the culture was shown, also point in the same direction.

From such observations as these, Kossowitsch concludes that the relationship which the Algæ bear to the microörganisms is one con-

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

nected with the organic food supply of these latter; he thinks that the Algæ, furnished with nitrogen by the bacteria, assimilate the carbohydrate material, part of which goes to their own maintenance, but part also to that of the microörganisms. It is, therefore, in his belief, an instance of symbiosis in which each supplies the wants of the other. There are many facts, partly the result of his own observations, partly the result of those of others, which uphold this view. If the mixed culture be placed in the light, there is a far more noticeable nitrogen increase than when in darkness. Again, if a rich supply of carbon dioxide gas be provided, this is marked by a decided rise in nitrogen-fixing powers. Both these conditions are such as are known to influence carbohydrate assimilation in chlorophyll-containing organisms; but all experience is antagonistic to the view that light should be beneficial to the vital activity of the bacteria, and there are only one or two exceptional instances (Nitromonas, etc.) in which carbon dioxide can be directly assimilated by these microörganisms.

Moreover, in the cases where the bacteria are bought into immediate contact with the Alga, as in those species of Algæ which are enveloped in a gelatinous covering wherein the microörganisms become imbedded, nitrogen fixation appears to be greatly aided, and the addition of sugar to the culture has no such marked effect as in the instances where non-gelatinous Algæ are employed. The explanation of this seems to be that the bacteria embedded in the gelatinous sheath are amply provided with carbohydrate food without the addition of sugar, which, therefore, comes more or less as a superfluity.

All this seems to justify Kosswitsch's view of the part played by the Algæ in the fixation of nitrogen; it appears to show that they have an indirect, but none the less important, influence upon the process. (Nature, Jan. 24, 1895.)

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Writers and publishers of botanical matter are earnestly requested to adopt the forms here recommended. Examples of various citations illustrating the application of the rules in specific cases are given. Correspondence may be addressed to Secretary of the Committee on Bibliography, 1284 Massachusetts Ave., Cambridge, Mass.

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b. Exact title, verbatim, following the capitalization required by the usage of the language in which the title is written, but not necessarily the capitalization employed.

c. Name of periodical or work, abbreviated in accordance with list of journals and catalogue of authors under recommendation 1. *a. b.**

d. Series, if any, in Roman capitals.

e. Volume number in bold face Arabic numerals, followed by colon. In case there is no volume number, the number of the part, heft, lieferung, or fascicle is to occupy this place but is to be printed in Arabic numerals of ordinary face. When a volume is composed of parts separately paged the number of the part shall be written as an index figure to the volume number. Volumes in parts with continuous paging require no designation of parts.

f. Page, in Arabic numerals of ordinary face. In case paging of the paper is in Roman numerals these should be used, preferably small caps. Re-paging in reprints and separates is to be indicated by enclosing the numerals in parentheses. In case the original paging is unknown an em dash should occupy its place, the reprint paging being given in accordance with the foregoing

*See Proc. Mad. Bot. Cong. 45. Je 1894.

rule. No individual or unique paging is to be cited under any circumstances.

g. Figures, plates and exsiccatæ are to be printed in Italic Arabic numerals, the number designating the figure or plate to be preceded by the abbreviations *f.* and *pl.*, respectively, in Italics. *d.* following a page number may be used, when desired, to indicate description of a species.

h. Exact date must be given if possible, written in the mode and with the abbreviations for months used by Library Bureau.* The year at least must be given.

i. Punctuation. Except the comma following the author's name, and the colon following the volume number all the items are to be separated by periods. If another citation follows in the same line it is to be separated from the first by an en dash. Specific, generic and varietal names are to be written and punctuated in the method used in the "List of Pteridophyta and Spermatophyta" issued under the direction of the Botanical Club, A. A. A. S.

j. If it is considered desirable to give other data than series number (if any), volume number, page and date, these should be added in brackets after the date. But useless or unnecessary data should be avoided.

k. Citations of reviews, abstracts, and all such secondary references should be enclosed in parentheses.

Examples.

1. **Lagerheim, G. von.** Ueber das Vorkommen von Europæischen Uredineen auf der Hochebene von Quito. Bot. Centralb. **54:** 324–331. 1893.
2. **Trelease, W.** A revision of the American species of Epilobium occurring north of Mexico. Rept. Mo. Bot. Gard. **2:** 69–117. *pl. 1–48.* 22 Ap 1891.
3. **Sargent, C. S.,** Editor. Populus monticola. Gard. and For. **7:** 313. *f. 56.* 8 Ag 1894.

*Those abbreviations are as follows: Ja, F, Mr, Ap, My, Je, Jl, Ag, S, O, N, D; i. e., the initial of the month followed by the first distinctive letter.

4. **Dietel, P.** Die Gattung Ravenelia. Hedw. **33**: 22–48. *pl. 1–5.* 30 Ja. 49–69. 15 Ap 1894.

The foregoing are correct forms for catalogue by author. The following illustrate cases arising under the rules indicated by the letter preceding.

5. Ell. and Everh. Pyren. 491. My 1892.

6. e. Proc. Phil. Acad. **1894**: 53–59. 1894.

The year number, 1894, is the volume number, and not necessarily the year of publication. E. g.,

7. e. Bessey, Am. Pomol. Soc. **1885**: 42. 1886.

8. e. **Mez, C.** Bromeliaceæ. III. Flora Brasiliensis 115: 425–634. *pl. 81–114.* 1 F 1894.

Not Fasc. CXV, 425–634, t. 81–114.

9. e. **Saccardo, P. A.** Syll. Fung. 7^2: 481. N 1890.

10. e. j. Bull. Geol. and Nat. Hist. Surv. Minn. 9: 39–42. 2 Mr 1894.

Not 9^2; nor 9 part 2; nor 1894 [part 2].

11. e. j. Linn. Sp. Plant. 6^2: 125. 1852. [ed. Willd.]

12. e. j. **Gray, A.** Man. Bot. 225. 1890. [6th ed.]

13. f. **Peck, C. F.** Rep. N. Y. Mus. **47**: —(18). N 1894.

14. g. Ell. and Everh. N. A. F. *1642.* F 1889.

15. g. Rept. Mo. Bot. Gard. **2**: 98. *d. pl. 28.* 22 Ap 1891.

16. i. Beringer, Am. Jour. Pharm. **66**: 220. My 1894.—Tulasne, Ann. Sci. Nat. Bot. III. **7**: 85. *d. pl. 2. f. 3.* 1847.

17. j. **Bailey,** The Japanese plums in North America. Bull. Cornell Exp. Sta. 62: 3–36. Ja 1894. [Illust.]

The figures are not numbered.

18. k. Ell. and Kell. Jour. Myc. **1**: 12. *d.* Ja 1885.—(Hedw. **24**: 45 *d.* Je 1885.) Peck, (Grev. **22**: 111. Je 1894.)

ZOOLOGY.

The Senses of Pilumnus.—The observations of M. Émile Racovitza prove that the otocyst of *Pilumnus hirtellus*, a small crab living in the rocks off Cape Abeille, near Banyuls, is an organ for feeling vibrations rather than for hearing. The crab feeds on small bivalves which live in holes in the rocks. When the bivalve moves its shell scrapes the rock and the vibration is communicated to the crab in his hole, whereupon he promptly sallies forth and proceeds in the direction of his prey, feeling for it with his claws. He appears to recognize his food by the sense of touch rather than sight, since any object used to scratch the rock will attract the crab and be seized by him as readily as if it were his favorite bivalve food. (Comptes rendus de l'Acad. d. Sci., CXVIII).

More Deep-Sea Fishes.—In the last number of the NATURALIST, we referred to the publication by Messrs Goode & Bean, of the U. S. Fish Commission, of some remarkable forms of deep-sea fishes dredged by the U. S. steamer Albatross. These were Hariotta, a new genus of Chimæroidei, at depths varying from 700 to 1000 fathoms; Rondletia, a new genus of Iniomi, from 1600 fathoms; and Cetomimus, also of the Iniomi, at from 1000 to 1500 fathoms. In the present number of the NATURALIST, we give figures of these remarkable forms, thanks to the Hon. Marshall MacDonald, U. S. Commissioner of Fisheries. We add to these, figures of three remarkable forms of the order Opisthomi, belonging to the families Notacanthidae and Lipogenyidae, the latter a new family defined by Prof. Gill. Two new genera of the former are called Gigliola and Macdonaldia respectively, and they are quite distinct from Notacanthus. Lipogenys possesses a peculiar suctorial mouth structure. The mandibular bones are said to be attached to the extremities of the maxillary, and to be "free behind." The lips are thick, rugose and contractile, and there are no teeth. The spinous dorsal fin is very short, and the eye is rather small. The only species is the *L. gillii*, which was taken at a depth of 865 fathoms.

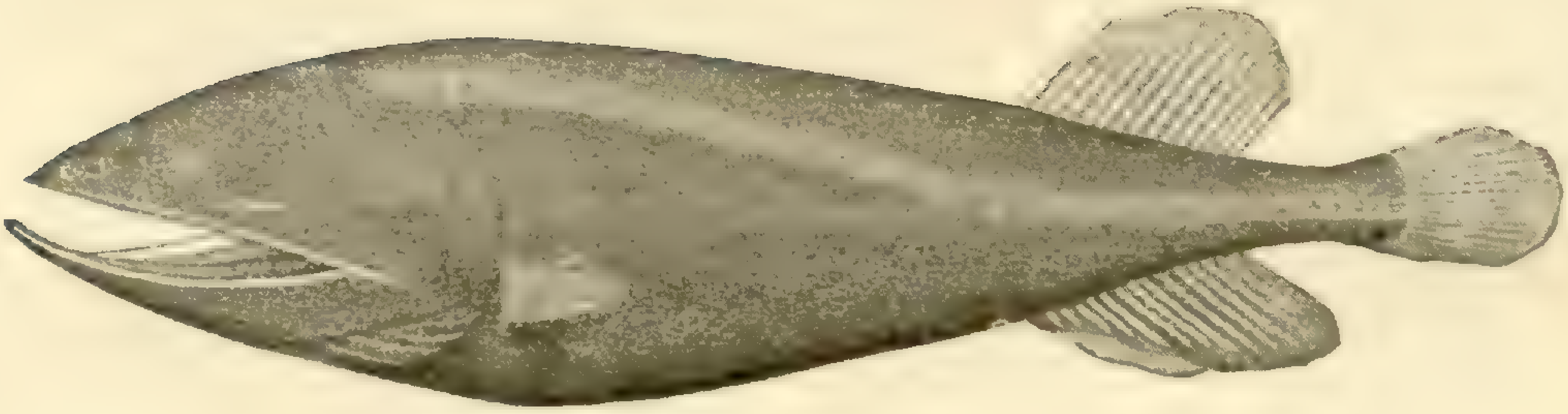
We should have preferred seeing some more-conspicuous zoölogists commemorated by these discoveries than Harriott and Rondelet; and we have a feeling that gentlemen who have passed over to the majority like these two and Sir Walter Raleigh, do not appreciate the compliment as much as they would have done had they been still with us.

PLATE XIX.

Hariotta raleighana G. & B; adult and young.

PLATE XX.

1



2

3

1. *Rondeletia bicolor* G. & B. 2. *Cetomimus gillii* G. & B.
3. *Cetomimus storerii* G. & B.

PLATE XXI.

1

2

3

1. *Gigliolia moselyi* G. & B. 2. *Macdonaldia rostrata* G. & B. 3. *Lipogenys gillii* G. & B.

Destruction of Food Fishes.—A gradual diminution of salt-water food fishes is reported all along the eastern coast of the United States. This destruction is caused by willful violation of game laws. The fish phosphate factories cause the disappearance of immense quantities of bluefish, bass and scup. The gill nets at the entrance to bays and harbors have almost exterminated the striped bass, which was once very plentiful, while early every spring pound nets are set for alewives, flatfish, smelts and flounders, and these are caught by the ton and spread upon the land as a fertilizer. The most destructive nets probably are the pounds, since they are made of fine meshed netting and cover an immense area. In some instances these nets are 4000 feet in length, and naturally catch immense quantities of cunners, killies, butterfish, white perch and young fry of the blackfish and sea bass which frequent our waters. It is to be hoped that stringent game laws will be adopted and that they will be stringently enforced. (Scientific American, Jan. 12, 1895).

A Swallow Roost at Waterville, Maine.—The following interesting account of a Swallow Roost is given by A. F. C. Bates in the January number of *The Auk.*

Not far from where a small stream called the Messalonskee joins the Kennebec River, one may see at evening, from the middle of July to about the third week in September, an interesting sight in the bird line.

The willow trees along the banks of this stream, particularly a close row some five or six hundred feet in length, form the roosting place of vast numbers of swallows. During the forenoon and early afternoon very few swallows are to be seen in the sky—indeed they are conspicuous by their absence—but a little before sunset the birds begin to arrive in the vicinity, flying, sailing, chasing each other around in the upper air, everywhere within the eye's reach. From north and south, east and west, in they come out of the distance till one thinks the barns, banks, martin-houses and swallow nests of whatever description all over Maine must have yielded up their inmates. Shortly after sunset they gather more nearly in the region directly above the trees, incomers from every point of the horizon still joining them, and toward the last exhibiting great hurry and intentness, as if fearful of being "late to meeting."

Then begin movements that are the most interesting feature of this gathering. At intervals *clouds* of swallows will evolve something like order out of their numbers and perform *en masse* some of the most

fantastic curves, spirals, counter-marches, snakelike twists and turns, with the sky for a background, that ever a company of genus Homo executed on a finely polished floor. For instance, one evening they separated into two parts, one going to the right, the other to the left, each division making a grand circle outward, then joining again for a forward movement. There were some stragglers, but the figure was distinct and was twice performed, with other evolutions interspersed. Then a long, snake-like movement from the upper air down, very slightly inclined from the vertical, with two twists in it, a loop around a tall tree farther down the stream and back, brought them into the tree-tops for roosting. That was the cleanest and most astonishing figure I ever saw them perform. Occasionally they drop down into the trees like pieces of paper, but oftener the final alighting is a combined movement, sometimes in the shape of an inverted cone—usually in a grand sweep after their most elaborate evolution. Frequently they swoop out from the trees company after company, several times before the last settling, their wings not only making a tremendous whirring, but a perceptible movement of the air. Their chattering keeps up from half to three-quarters of an hour after they settle in the trees, and their dark little bodies against the sunset sky look as numerous as the leaves. Often they weigh down a branch and then a great chattering, scolding and re-adjustment ensues. Sometimes there is a movement through the tree-tops to one spot as if a conference were called, and a more surprising amount of chattering than before. Then in a few minutes back they come till the tree-tops are about equally full. The noise which they make is suggestive of the whirring of looms in a cotton mill, heard through the open windows, or of some kinds of water-falls.

They leave the trees in the morning a little before sunrise. August 26th we watched them go out. At 4.15 there were sounds as if of awakening and gradually the noise increased. At 4.25 they began to arise in companies at intervals of two or three minutes. They did not remain long in the locality and by five o'clock not one was to be seen.

The Distribution of Seeds by Birds.—I have just sent a MS on The Dissemination of *Yucca aloifolia* to Professor Trelease for publication in the Missouri Botanical Garden Reports. My attention has been called to certain observations therein of a zoological nature that seem rather remarkable. I am convinced that the observations are correct, but am not informed on the literature of the subject and thus

do not know whether to consider the facts novel or not. Probably you may be able to inform me in regard to the subject.

In connection with my work on dissemination, I was led to feed a captured mocking-bird on various fleshy fruits. I found that they apparently digest their material with what would seem to me great rapidity. As illustrations, I fed the bird with some 15 seeds of *Yucca aloifolia*, noting the time when they were swallowed. One of these seeds, and there could be no mistake, was evacuated in slightly over 15 minutes after the first seed was swallowed, and the majority of the seeds were evacuated by the end of half an hour. At another time some 15 seeds were given to the bird and the majority were evacuated in half an hour and all in an hour. The bird was given access to an entire Yucca fruit and ate and evacuated 51 seeds in about 4 hours.

I tested the bird also with poke berries (*Phytolacca decandra*) and found that all excrement became stained in a very few minutes, while the seeds usually began to be evacuated in considerable numbers in half an hour and the majority had passed in three-quarters of an hour. The same held true with the seeds of *Durantia plumeri* and *Melia azederach.*

The question then is whether the evacuation of seeds in from 15 minutes to half an hour, making the entire passage of the alimentary canal in that time, would be considered at all uncommon. It may be that such fruits have a purgative effect on the bird and hasten matters somewhat. I would be greatly obliged for your opinion on this subject. I merely mention the thing incidentally in my paper, but my observations were carefully made.

H. J. Webber.

The Effects of Cold.—L'*Eleveur* reports that the wild boars, which are very numerous in the forests of Luxembourg, driven by cold and hunger, roam through the streets of the villages. Also that the wolves have come down from the Vosges Mountains to the plains in vast numbers. If these animals are experiencing such suffering through cold, it is not surprising to hear that the game birds in the preserves of Marly and of Rambouillet are perishing from the same cause. Each day the guards find great numbers of pheasants and partridges frozen to death. In this connection is mentioned a singular fact observed by an English farmer. He owned four peacocks which were in the habit of coming at his call. He noticed that for two days one was missing. The third day he saw two of the peacocks vigorously scratching away the snow to the depth of a meter. On going to

their assistance he found the missing bird buried in the snow and fastened down to the ground by his tail, which was frozen in a pool of water. A few hours after his release the peacock had perfectly recovered. (Revue Scientifique, Fev., 1895).

Zoological News.—A study of the Crista of the large intertropical Trombidiums (*T. tinctorium,* etc.) leads Dr. Trouessart to the conclusion that the organ in question is not only an organ of hearing, but that it is also the remnant of the median anterior eye, now atrophied. This example of organs of different senses joined together by growth is unique among Arthropods, although there are cases among certain insects where antennae are found inserted near the centre of the eyes. (Bull. Soc. Entomol., Paris, 1894).

In Chapman's "Guide to a Collection of Birds found within 50 miles of New York City," it is stated that 348 species are known within that radius, and these are classified as follows: Permanent residents 35; summer residents 92; winter residents 36; summer visitants 18; winter visitants 16; regular transient visitants 82, irregular 30; accidental 39. The collection belongs to the American Museum of Natural History.

ENTOMOLOGY.[1]

Two more new species of Lecanium.—(1). *Lecanium pseudhesperidum*, Ckll., n. sp.—♀ scale of the general shape and appearance of *L. hesperidum*, but (at least in spirit) firm in texture. Length 6½, breadth 3⅓, height 1 mm. Color reddish-brown, moderately shiny, pitted but not ridged or grooved; rows of apparently glandular patches on the dorsum. This description is from a ♀ packed with eggs; empty ♀, from which the eggs have hatched, are sometimes rather larger, and appear whitish or nearly colorless.

Derm colorless, very distinctly tessellated, the tessellations not containing gland-spot. Rather large gland-pits scattered at irregular intervals.

Margin with slender spines, often curved, never branched. Lateral incisions each with a stout blunt brown spine, and a second rudimentary or very small. Anal plates small, about 1⅓ mm. from hind end. Anogenital ring with numerous hairs. Mentum 2-pointed, rounded at end.

Legs ordinary; coxa and trochanter each with a hair at end; tarsus scarcely if at all shorter than tibia. Claw stout, hooked at tip. Digitules ordinary, well-developed, slender but not filiform.

Antennæ very pale brownish, well-formed, but the joints indistinct, 6 joints, 3 much longest, about twice as long as 2, and a little longer than 4+5+6. 4 shortest, then 5 and 1 about or nearly equal. 6 about as long as 2. Formula 3(26)(15)4. 1, 2 and 3 each with a long hair near the end; 6 with many hairs.

Hab., on *Cattleya* in greenhouse at Ottawa, Canada (C. E. F.), Dec. 15, 1894. Sent by Mr. J. Fletcher. The native country of the species is unknown, but it is most probably neotropical.

This interesting species looks very like the common *L. hesperidum*, but in its tessellated skin more resembles such species as *L. depressum*. The tessellation is microscopical, so the species could not be taken for *L. perforatum* as *tessellatum*. With it were sent (also in alcohol) three or four examples of an *Anlacaspis* from the same plant. No satisfactory study could be made of this from the material received, but it appears to be *A. boisduvalii*, (Signoret).

(2). *Lecanium lintneri*, Ckll. and Bennett, n. sp.—♀ scale very flat, practically circular in outline, about 5½ mm. long and 5 broad; dark

[1] Edited by Clarence M. Weed, Durham, N. H.

chestnut brown, shiny, subreticulately wrinkled. Removed from the bark it leaves a rather indistinct white patch.

♀ " Derm orange-yellow, with gland orifices. Marginal hairs short, scattered.

" Antennæ seven-pointed, 7th joint about ⅓ longer than 1st, emitting 4 or 5 long hairs. 1, very broad, a little broader than long. 2, about as long as 1 is broad, 3 a little longer than 2 ; 4 a little longer than 3, the point between 3 and 4 being almost indistinguishable, causing 3 and 4 to appear as one long joint. 5, two-thirds as long as 2. 6, a little longer than 5. Formula 4(73)2165.

" Legs : coxa short, broad, has one hair ; trochanter almost as long as coxa ; femur 2 times as long as coxa ; tibia ¾ as long as femur ; tarsus shorter than tibia. Claw small, not curved. Big knobbed digitule on tarsus larger and thicker than on claw. Anal ring with long hairs, perhaps only 6." (Joseph Bennett, MS.)

Hab.—On Sassfras, Lake Mohonk, Greene Co., N. Y., June 15, 1894. Found by Dr. Lintner, to whom it is dedicated in recognition of his great services to N. Y. Entomology. The material was small in amount, and were the species not so very distinct from anything yet described I should hestitate to publish it. The scale is not very unlike that of some *Pulvinaria*, but there is no ovisac, though young had been produced by the specimens examined. *Lecanium tulipiferæ* Cook, as figured by its author, looks as if it might possibly be this species ; but the figures are bad, and I have received from Mr. L. O. Howard good specimens of *tulipiferæ*, from Virginia. These specimens show that *tulipiferæ* resembles such forms as *tiliæ* and *æsculi*, and has nothing to do with *lintneri*.

Most of the description was written by Mr. Bennett, a former student of mine.

T. D. A. Cockerell, N. M. Agr. Exp. Sta.

A new Trombidian.[2]—The accompanying plate XXII shows a new North American trombidian which the writer found on the feathers of the black flycatcher (*Phænopepla nitus* Sev.) from Casa Grande, Arizona. By way of introduction some notes about this species may be outlined before the more detailed description is given, which is left till the last. This mite appeared on the surface of the plumage of two dried skins of the above bird, which had been laid away after separating from the flesh, for a time enclosed in paper cylinders. This fact

[2] Read before the Entomological Section of the Chicago Academy of Sciences, January 18th, 1895.

is mentioned as they proved useful in preserving the mites which had previous to their death made their way to the surface of the feathers. In the uncovered skin, moreover, parasites make an effort to crawl away or are lost in handling. It is not known on what part of the tissues of the bird the present species of parasite inhabits, but from the knowledge given to us by the writers mentioned further on, we may infer that either the connective tissue or the feather furnishes its nourishment, or, perhaps, as in the case with some other members of trombidians (Cheyletinae) they may feed upon the other forms of parasites which frequently live upon the same bird. All this is speculative with relation to the new species under consideration as we have not had as yet an opportunity of personally examining living specimens.

On the shining black back ground of feathers this mite appears as minute whitish specks distributed quite generally over the body of the two birds seen. They are easily removed with the point of a needle to which they can be made to adhere by mere contact, by reason of the long hairs which is such a characteristic feature of the example before us. By reason of this also I have given it the name *villosa.* Transferred to the slide of the microscope they are seen to be shrivelled and of course lifeless. An immersion in pure glycerine caused the tissues to regain to a striking extent what would apparently be the natural rotund appearance of life. Some twelve specimens of both sexes gathered from the birds were studied, the most of these being matured individuals. Selecting one which was characteristic, I made the drawing of the female referred to in the beginning of this paper. While a number of species have been described, from time to time, the literature is not extensive and that which interests us most in the present connection is foreign. In 1878 G. Haller[3] found a remarkable vermicular shaped trombidian in the connective tissue of the ash-colored woodpecker (*Picus canus*) and described it under the generic and specific appellation *Picobia heerii.* In the following year 1879, A. Heller of Kiel, found similar forms inside the feathers of poultry, pigeons, and peacocks. To all appearances these Acarina all belong to the same genus *Picobia* notwithstanding the latter observer described two new species under a newly created genus to which the name Syringophilus was given. We could not pass without mentioning this as we think the new form here described, for the first time, enters into the genus Picobia of Haller, while it resembles, as far as description goes, to some extent the species *Picobia* (*Syringophilus*) *uncinata* Heller.[4]

[3] Freyana and Picobia Zutschrift fur wissenschaftliche, Zoologie, XXX, 1878, p. 81.

[4] Die Schmarotzer, 1880, p. 186.

Description of *Picobia villosa*, sp. nov.—Length of body, male .7 mm. breadth .20 mm. The female is slightly larger. Body elongated, rather rotund; palpi abbreviated; legs strong with five joints; tarsus of all the legs terminating in two chitinous Ctenidium or comb-like structures, the body of the latter thickened, convexed on the outer side straighter on side giving origin to the teeth, at point of attachment to tarsus the diameter is lessened and becomes rounded between the claws, the teeth constituting the comb are graduated in length being longest at free end, becoming shorter toward tbe articulation as shown in Fig. 2, the teeth are also notched at their extremities the last tooth of the fourth pair having six denticles. Within the end of the tarsus, on each side, is inserted, by a stalk, an accessory delicate hyaline vertically flattened appendage, see Fig. 2a, it is split up a part of the way into about nine sharp terminations which divaricate slightly; they project to the outer side of the claws, their ends overhanging like fringe. At the end of the tarsus, corresponding to a point at the base of the combs, two curved claws are present as shown in Fig. 2. To the naked eye the body of this mite is whitish. Through the microscope it appears almost transparent except where food masses occur in the abdomen. A number of blackish hairs are found, on the legs, body, and especially at the end of the abdomen where some, here, attain an extraordinary length. In the plate these are curved so as not to take up unnecessary room.

Explanation of Plate XXII.

Fig. 1. *Picobia villosa* Hancock, original, greatly magnified, semi-transparent view.

Fig. 2. Tarsus seen from the side showing comb structures, the claws, and accessory stalked appendage (shown at a).

Chicago. Joseph L. Hancock.

PLATE XXII.

Fig. 1.

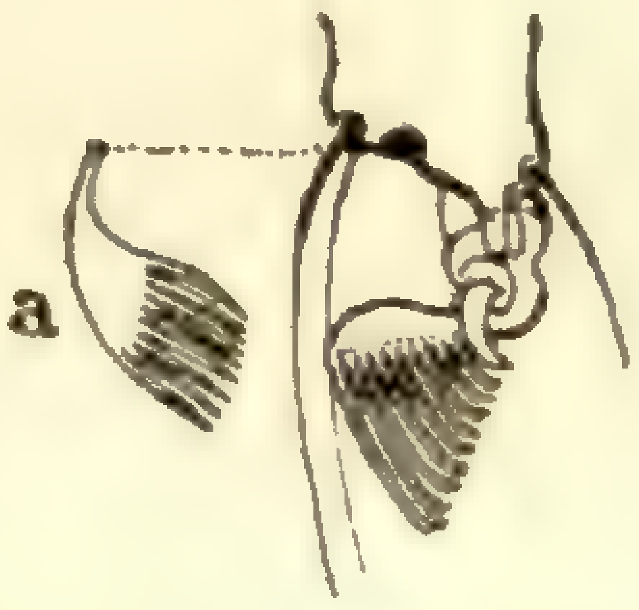


Fig. 2.

Hancock on Picobia.

EMBRYOLOGY.[1]

Cytotropism.—Professor Wilhelm Roux, the leader of the new school of Embryology that seeks to investigate developmental phenomena by the aid of experimental methods, has published in his new periodical some very interesting results obtained on his often used object, the frog's egg.[2]

The eggs were teased apart in salt solution, white of egg, or in a mixture of both, and observed under precautions necessary to prevent currents and jars in the liquids. When so treated the isolated cells, for eggs are used in later cleavage and bastula stages when each is divided up into many cells, lie in the liquid at varying distances from one another and quite separate.

It is now found that movements may take place that results in the union of some of these isolated cells. These movements are a gliding or creeping, since the cells lie on the glass slide and not suspended in the liquid. In many cases, especially when salt solution is used, the cells throw out pseudopodia that may be all clear protoplasm or else contain a granular axial mass. These may anastomose with pseudopodia of other cells. The pseudopodia, however, are not concerned in the motions which are actual translations of entire cells without any visible means or cause.

The movements do not take place between all cells and seem to vary in power in the same cells. In the frog *Rana fusca* eggs from the latter part of the breeding season show no movements. In other species namely *R. esculenta*, *Bombinator igneus* and in the fish *Telestes agassizii* no movement could be detected.

In detail these movements are found to be of limited extent but yet capable of resolution into considerable complexity. Only cells having diameters of from 20 to 60 microns show the phenomena and only when not more than their own diameter apart. We are thus dealing with migration of small amounts of matter along very short distances. The cells move along the shortest distance between them but not without vibrations from side to side. The latter part of their course when about to unite is generally more rapidly accomplished than the first. A few minutes to an hour or two may be taken in moving these short distances, e. g. 40 microns.

[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts, reviews and preliminary notes may be sent.

[2] Archiv f. Entwicklungsmechanik, Vol. I. Oct. and Dec., 1894.

Larger cells may move toward smaller and vice versa, or both toward one another.

When three cells are concerned one may move toward another directly or may at first move as if in the resultant line of forces proceeding from each of the other two.

Mass does not seem concerned in these movements for several cells in a group (not separated from one another in the teasing) do not act as a whole, but one of them may attract or else be attracted by some isolated cell lying near.

Many cells may eventually come together and form a firm aggregate out of a scattered collection of isolated cells.

It appears that these attractive movements take place between cells of separate eggs as well as between the cells of the same egg. Moreover, it was found that the cells of later stages, of the gastrula and young tadpole stage, may move. Thus cells that were forming the nervous system may, when isolated, round themselves off, become amœbird and even, in some cases, draw together till they touch.

Besides the change of position hitherto mentioned there is a marked change of form. In general two active cells protrude on the side towards the other cell so that they may be said to flow out towards one another to a certain extent. There is also considerable change in outline, elongation and contraction of the cell while moving or while serving as the centre of attraction or of movement for another cell.

A cell may even divide while also moving towards another.

The explanation of these complex movements of isolated cells in the frog embryo remains for the future, but provisionally the author refers them to the general class of movements brought about as the result of chemical action. That they are not simply physical, but results of life in the cells, the author seems to prove by careful examination of the sources of error and by controlling the conditions of experimentation.

He would class these movements with those of sperm cells towards ova and of conjugating infusoria towards one another as cases of Cytotropism; he pictures to himself a chemical or chemotactic source for the movements by supposing that the cells secrete chemical subtances that effect other cells so as to direct their movement as well as to incite it. This movement under the stimulus of adjoining chemicals would differ from that observed by Pfeffer, in that here the cell does not move towards the region of greatest concentration of substance, but, in that it moves to another cell and thus into the field filled by substances from two cells, towards the region where the substance is least dilute.

Since this cytrotropic state seems to vary in any cell it may play a varying and not unimportant part in the phenomena of ontogeny.

By its instrumentality, cells may, at one time unite, at another, remain separate. Migrations of cells towards oxygen on the surface of the egg, etc., would also be exhibitions of these same cytrotropic powers.

PSYCHOLOGY.[1]

In his "Introduction to Comparative Psychology," (*Contemporary Science Series*, Walter Scott & Sons, London), Professor Lloyd Morgan's central object is, he tells us in his preface, "to discuss the relation of the psychology of man to that of the higher animals...a secondary object...is to consider the place of consciousness in nature, the relation of psychical evolution to physical and biological evolution and the light which comparative psychology throws on certain philosophical problems." As far as the formal element in his book is concerned, Professor Morgan makes no claim to originality. He has made use, so far as I can see, of three architectonic principles. The first of these is the symbolic conception of consciousness as a "wave;" the crest of the wave corresponds to the "focus of consciousness," more usually called the centre of attention, while the other portions of the wave represent the "marginal" elements, those of which we are conscious but to which we are not attending. The second is the conception of "relations" as "the momentary feelings accompanying transitions in consciousness." The first of these conceptions Professor Morgan credits to Professor James, of Harvard; the second to Mr. Spencer. The third principle he does not explicitly mention in his preface, probably because it would be difficult to ascribe it, in the form in which it is stated by himself and others, to any given individual. It is the conception of a selective, synthetic activity as characteristic of subject and object alike; this, in the object, is the activity manifested in the objective sequences which are formulated as natural laws; in the subject it is that "to which the term Will is properly applicable" (page 315).

In the few pages of Prolegomena the doctrine of monism is briefly outlined, first, as the monistic theory of knowledge, second, as the monistic interpretation of nature, third, as a monistic analysis of nature into mental and material "aspects," distinguishable in thought but not separable in existence. The first three chapters preparé the way for the detailed discussion that follows. The conception of consciousness as a wave is made plain in chapter I; in chapter II, on the "Physiological Conditions of Consciousness," it is shown that it matters little whether we take as our working hypothesis the pure monistic

[1] This department is edited by Dr. Wm. Romaine Newbold, University of Pennsylvania.

identification of the mental and physical series or the empirical dualism commonly known as the doctrine of parallelism. Chapter III inquires into the inevitable limitations of the method of analogy as applied to the interpretation of other minds than ours.

In the thirteen chapters following, Professor Morgan applies himself to the purely psychological part of his work, and throughout, after devoting a chapter or two to the analysis of the phenomena of the human mind, he endeavors in the next chapter to determine whether analogous mental states are to be ascribed to animals other than man. He begins his inquiry with the more concrete phenomena of the specifically inner life and concludes that in the lower animals concrete representative ideas are suggested by sense impressions, associated with one another and remembered very much as they are in ourselves. He then takes up the difficult problems of sense experience in the chapter on the "Analysis of Impressions;" the ultimate elements of impressions are distinguished as sensations of various kinds; the chapter on "Synthesis and Correlation" then undertakes to show "how these sensation elements are combined synthetically to form impressions as we know them; how they enter into correlation with each other; and how they call up through association representations of similar sensation elements." Under the caption "The Sense Experience of Animals," Professor Morgan gives his reasons for concluding that the sense experience of the higher vertebrates is much the same as our own, while of that of the lower forms of life we probably can form no representative idea whatever.

Chapter XI develops in sharp relief the doctrine of lower (i. e. subcortical) automatic centers standing under the control of higher (cortical) centers whose augmenting or inhibitory activity is in turn determined by sensory (conscious) centers. The activities of these latter centers, again, are determined by the emotional tone associated with their functioning. Professor Morgan also inclines to the belief that special centers exist for the control of these purely sensory centers (pp. 194–5). Chapter XII, entitled "Instinct and Intelligence," applies these principles to the explanation of the conduct of animals, showing that while animals may act instinctively, their habits are for the most part empirically determined by the method of trial and error, and consequently must be regarded as fully conscious. To this method of trial and error Professor Morgan would restrict the term intelligence.

Chapters XIII and XV on the "Perception of Relations" and "Conceptual Thought," are perhaps the most suggestive in the book. A relation is the transition between two focal states of consciousness;

originally marginal, it in the course of evolution becomes focal. This is probably due to the necessity of intercommunication, which can be carried on in terms of relation only, and language has been the instrument by means of which this immense advance in mental evolution has been effected. When a given relation is not only itself focal, but is apprehended without reference to any particular terms related, it is called a concept. Abstraction is a process involving a great relative intensification of the focal element to the greater or less exclusion of the marginal elements—it is, therefore, essential to the development of concepts. There is no evidence to show that the lower animals can perceive relations or form concepts. And if we take "reason" as involving an apprehension of similarity of relation in things diverse, we have no evidence for the ascription of reason to animals other than man.

The three following chapters are rather metaphysical and philosophical than psychological. Chapter XVII expands the conception already outlined in the Prolegomena of subject and object as later differentiations of an originally homogeneous experience, and endeavors to identify that selective, synthetic, orderly and determinate activity which in the object we term the operation of natural law with that similar activity which in the subject we term Will. Self-consciousness in its most highly developed form involves "first, the conception of the subjective as distinguished from the objective; secondly, the concentration of the net result of all subjective experience into one generalized concept; and thirdly, the further conception of this net result as due to the determinate working of an activity which is synthetic and selective." This form of self-consciousness is attained by relatively few men; in the lower animals it is not probable that it exists at all.

Chapter XVIII takes up what in the Prolegomena is called the monistic interpretation of nature, and develops the conception of consciousness as a product of organic evolution. Chapter XIX, on "Selective Synthesis in Evolution," carries on in like manner the monistic analysis, endeavoring to trace throughout the inorganic and organic world the varying manifestations of that selective, synthetic activity which the monist regards as the ultimate essence of all.

Chapter XX and last, returns to psychology proper and compares the emotional and moral life of men and animals. The emotions of some of the lower animals are probably very like those of man. This is true especially of the offensive and defensive emotions, and to some degree of the sense of the beautiful. But there is no reason for

believing that brutes can form an aesthetic judgment or attain to an aesthetic or moral ideal.

It is not my intention to enter into any detailed criticism of Professor Morgan's book, yet there are some points which he will, I hope, make clearer in his forthcoming "Psychology for Teachers." I do not clearly see the laws by which the transition from the concrete to the general relation is effected; I would like to know why the word "concept" is to be restricted to generalized vector states and denied of analogous static states; I would like to see the doctrine of "automatic" centres and "control" centres brought more into harmony with the results of introspection; and I would like Professor Morgan to show why he identifies the selective, synthetic activity of nature, not only with the intrinsic properties of mental states, such as tendencies to development, to suggestion of ideas, to the production and prevention of muscular contraction, etc., which are its true analogues in the inner life, but also with that enigmatic activity of will, which seems at times to run counter to all these momenta and to determine thought and conduct in a fashion diametrically opposed to the provocation of the immediate environment. That this activity is without determinate laws I do not for a moment believe. It is probable that in it we see the present, conscious representative of our total individual and hereditary experience in some way brought to bear upon the immediate present. But as I do not think that even descriptive psychology can afford to ignore it, so I would not hastily identify it with any other phenomenon of inner or outer experience. That tendency to identify the energy or activity of the objective world with the "will" of the subjective world which has been more or less noticeable in philosophy since the days of Schopenhauer, is but a more refined form of the animistic theories of our prehistoric ancestors and of their successor, the theistic interpretation of nature which is still current. That there may be truth in such theories I am not prepared to deny, but as they cannot be tested by appeal to experience, nor are essential to the construction of a scientific conception of nature, they have at present no place in a reasoned scheme of knowledge.

One other point calls for comment. In his chapter on the physiological conditions of consciousness, Professor Morgan has, I think, failed to make use of the suggestive material brought to light by recent researches into what Pierre Janet calls "la désagrégation psychologique." It would, perhaps, be too much to say that the study of mental disorganization has established the possibility of mental states existing in connection with a given brain without forming part of the

"consciousness" normally related to that brain. But there is certainly much evidence for this hypothesis, and, if we adopt it, it would obviate all the verbal absurdities of "unconscious consciousness" and the sundry difficulties that attach to other theories. Moreover, the theory is directly in line with Professor Morgan's fundamental conceptions and I am rather surprised that he has not felt inclined to make more direct use of it.

Taken as a whole, Professor Morgan's book is without doubt the best introduction to psychology for mature minds that we possess. It is admirably clear, coherent and consistent. Notwithstanding his disclaimer of originality, in so far as regards his architectonic principles, it is not too much to say that he has succeeded in utilizing those principles for the organization of his bewilderingly complex material with greater success than has attended the efforts of either Professor James or Mr. Spencer. Many of us who are accustomed to use in teaching psychology the synthetic method which Professor James condemns so vigorously, have done so, not because we were especially wedded to the synthetic method as such, but because all attempts hitherto made to present the subject analytically only result in confusing the beginner. Professor Morgan's book seems to me the first successful attempt to make psychology intelligible by the analytic method, and I intend to try at once the experiment of using it as a text-book with beginners.

Furthermore, the book is most refreshingly free from the phraseology of the schools. The old tripartite division of the Englishmen and the "faculties" of popular superstition are conspicuous by their absence, and the reader is brought face to face with the facts. Throughout, the influence of Professor James' stimulating example seems traceable, but there is a consistency and precision in Professor Morgan's thought which one misses in Professor James'. It is true that precision and consistency in psychology can be attained, in the present state of the science, only by the sacrifice of much that the candid student would like to know, and a critical reader would doubtless sow Professor Morgan's pages thickly with interrogation points and carets. But the beginner needs most of all clearness, precision and substantial accuracy; the further processes of exception, modification and introduction of alternative theories are best deferred to a later stage. Professor Morgan has had the needs of the beginner in mind and has met them better than any contemporary writer.

ARCHEOLOGY AND ETHNOLOGY.[1]

The Antiquity of Man at Petit Anse (Avery's Island), Louisiana.—In digging fifteen and twenty feet through superficial soil into a very pure deposit of rock-salt, on a low hill at Avery's Island, west of New Orleans, some miners found, on the authority of Mr. T. F. Cleu (quoted by Professor Henry of the Smithsonian Insitution, Trans. Chic. Acad. of Sciences, Vol. I, part 2), a fragment of ancient cane matting near the top of the salt, and fourteen feet below the surface of the soil.

What made the discovery noteworthy was Mr. Cleu's statement (see Foster's Prehist. Races of the U. S., p. 56, and Nadaillacs Prehist. America, p. 36) that remains of the tusks and bones of a fossil elephant were found in the same soil two feet *above* the matting. Professor E. W. Hilgard and Dr. E. Fontaine afterwards (1867) said they found incredible quantities of pottery mixed with elephant and other large fossil bones at a depth of 12 feet below the surface.

By that time a good deal of digging for salt had been done in the mines by white men, and the investigators of the locality seem to have drawn their deductions from what they saw and what they heard from workmen in these pits. Some of the observers thought that the layer of loam covering the salt had been washed down from the surrounding hills. But its age would have been best settled by geological data of the bones it contained if the bones were in situ.

Whether the fossil bones were part and parcel of the loam or not, the important question is—were the human remains (basket work, pottery, etc.) contempory with the fossils, or were they not contemporary? And this has not been settled, for we do not know whether the comparatively modern Indians dug pits through the loam down to the salt just as the white men dig them now, and whether, in such case, their pottery and basket work finding a way naturally to the bottom of their pits, had not thus become mingled with an underplaced bed of animal remains already resting on the salt.

Comparatively recent peoples in Europe have dug graves and buried skeletons on cave floors so as sometimes to let down their relics into more ancient company when the graves happened to penetrate in-

[1] This department is edited by H. C. Mercer, University of Pennsylvania.

to older geological layers, and thus the most modern object in the world can be intruded into the most ancient stratum known.

Until this question of previous salt-pit digging by Indians is clearly settled, we must remain in the dark as to the meaning of the objects thus far found at Petit Anse.

The following notes upon a recent examination of the spot by the late Dr. Joseph F. Joor, has been kindly sent me by the President of Tulane University, of New Orleans.—H. C. MERCER.

Notes on a Collection of Archeological and Geological Specimens Collected in a Trip to Avery's Island (Petit Anse), Feb. 1st, 1890. By Joseph F. Joor, M. D.—About the end of January, 1890, President Johnston, of Tulane University, learned that the New Iberia Salt Co., in opening a new shaft, had exposed a number of Indian relics and remains of extinct animals. As the Professor of Geology could not then leave, he requested me to proceed at once to the spot, and secure as many specimens as possible for the University Museum; also to learn all I could of the Archaeology, Geology, and Natural History of the Island.

Accordingly, I left New Orleans, January 31st, reaching the Island the same evening. I was most agreeably and hospitably entertained by Mr. and Mrs. McIlhenny and the Avery brothers, who also gave me valuable assistance during the eighteen days' of my stay. The officers of the Salt Company also extended many courtesies, without which my work would have been greatly hindered.

The excavation formed a rectangle about 50 x 90 feet at top, and 30 x 70 at bottom, with sloping sides—the greater length being north and south. The depth to the salt varied from 16 to 25 feet. The layers penetrated at that time, at the northwest corner, were:

1st. Soil, 6 inches.

2d. Yellow clay, with some sand, 4–6 inches.

3rd. Black stiff loam, or swamp muck; 10–12 feet (pottery bed).

4th. Blue clay, with pebbles (bone bed), 2 feet or more.

This last was only partly removed at the time of my arrival, and from it came our paleontological specimens. Immediately below was the salt, with a very irregular surface, its hollows filled with the clay, which thus in some spots was nearly ten feet deep. The upper layers varied considerably in different parts, both in relative thickness and character. At the northeast corner, for instance, the yellow clay is partly replaced by sand. But the most important differences were in the loam. At the north end, near the northeast corner, a hollow,

probably the work of human hands, was scooped in the upper part of this layer to a depth of 3 or 4 feet, and completely filled with *ashes*, containing thousands of bits of pottery. One of the sloping approaches of the shaft was cut through this deposit, exposing a section about 10 or 12 feet long (north and south) by 4 or 5 feet wide, where it abutted on the main excavation. On the east side, 20 or 30 feet from the northern end, was another rounded hollow in the loam, 10 or 15 feet wide, where it was cut across, and 5 or 6 feet deep in the middle. This was filled with *sand*, mixed with black vegetable mold. At the north side of this, and extending into the adjacent part of the loam, were other bits of pottery, less numerous than in the ash bed, but in larger pieces. Here were found our largest specimens of earthenware.

Ten or twelve feet southwest of this last spot, and inside the rectangle of the shaft, was a live-oak stump, over 2 feet in diameter, and 3 or 4 feet high, with its roots still fast in the upper part of the loam on the east side, but tilted over to the west, as if it had been on a caving bank. The upper part of this was broken off as if by a tornado. The wood was still sound, and so tough as to necessitate the use of dynamite for its removal. It was considerably stained, as if by the infiltration of *iron*.

In the corner was what looked like a gully, 6 or 7 feet deep, hollowed in the loam, and filled with a mixture of ashes, sand and vegetable mould, with a few pieces of earthenware. Through this a pretty bold stream of water entered the excavation. All these inequalities in the loam were covered and approximately leveled by the yellow clay.

All of the larger pieces of pottery, and most of the smaller bits, were entirely destitute of ornamentation. Some of the lesser pieces, however, are marked with patterns of various kinds. Some show lines, generally oblique, apparently drawn with a pointed stick; others dots, looking as if they might have been made with a bit of cane. But some appear to have been *stamped*.

Our largest specimen represents rather less than half the circumference (at top) of a jar about 9 inches in diameter, and over a foot deep—the bottom entirely gone. It seems to have been somewhat narrowed below. This was broken into eight pieces in extricating it from the mud. Many of the other fragments indicate still larger vessels. They are all very thin and exceedingly fragile.

Before my arrival the workmen found two or three whole jars, which, however, were immediately smashed, probably from the idea that they contained treasure. Superintendent McCalla, however, rescued a large piece of one of them, which he presented to us. It is about half of the

lower segment of a jar nearly four inches in diameter, but narrowed at bottom. The fragment is about 5½ inches high. These jars were found near the oak stump.

Near the southern end of the excavation a piece of cane basket was exhumed. It was taken—still in the lump of mud—to Mr. E. McIlhenny, who still has it. It is of a very coarse make, and about 4 inches square. Mr. McIlhenny has given us the lump of mud with some bits of cane still sticking to it, and the impress of the remainder. It seems to have come from the lower part of the loam, below the level of most of the other human vestiges.

Mixed with the pottery everywhere were bones (mostly those of deer) with shells of a small tortoise, and of the same clam now found in Lake Ponchartrain—*Gnathodon cuneatus ;* also a few mussels (Unio).

The loam was generally penetrated by small roots, most of them apparently those of marsh grasses or cane, with some of exogenous trees or shrubs. On the east side there were a good many leaves of live oak (*Quercus virens*), wax myrtle (*Myrica cerifera*) and others not identified. Some of these leaves (oak, myrtle and others) were *still green.* This phenomenon I can only explain by supposing the freshly fallen leaves to have been buried under a caving bank, and hermetically sealed by the stiff, waxy soil, which had never since become dry enough to admit the air. The leaves began to fade within half an hour, and in three hours had the ordinary brown color of a macerated leaf. They were seen while green by Manager John H. Hamilton and Mr Hausman of the mining company ; Capt. Jas. Hare, of the U. S. Lighthouse Service, Mr. and Mrs. McIlhenny, Capt. Dudley Avery, and others.

We also found, at the same spot, some bent and twisted strips of bark, that were, perhaps, handles of baskets. They are badly decayed, however, and do not prove much.

The managers of the mine conjectured that the ash-bed marked the site of a pottery kiln, while the hollow in the loam on the east side was made by digging out material for the ware. But, to my eyes, the hollow looked more like the work of nature. I rather lean to the opinion that the ash-bed indicates a *furnace* for boiling down the brine of a salt spring, and that the pots were used for that purpose. Both theories may be correct.

I see no reason for assigning any very enormous antiquity to these relics. Most of them were covered by 5 or 6 feet of loam or less, and about the same of yellow, sandy clay and soil. The two last layers appear to be a " wash " from the neighboring hills, and may have been formed within a century, while three or four hundred years would be

enough for the loam, especially if there was a slight gradual subsidence, so as to keep it subject to overflow. The deeper specimens were found near the south end, where there are signs of a gully or hollow of some kind, which would fill more rapidly than the higher ground, if the cause which produced it were removed.

It is somewhat remarkable that not an arrow-head, weapon or tool was found in the excavation, although such articles are not rarely found at or near the surface, in the neighborhood.

In the blue clay, 16 to 20 feet from the surface, and immediately overlying the salt, were an immense number of bones. Unfortunately, most of these were badly decayed, and the clay very tenacious, so that most of them were destroyed. The Avery brothers, however, secured a good many of them, in the early stages of the work. Most of these they gave to Mr. McIlhenny, the rest to this University. I secured several hundred teeth, bones and (mostly) fragments, after reaching the ground. These represent the following animals:

A small Mastodon.

One or two species of Equus.

Mylodon harlanii.

Of these I am pretty certain. It is probable that there are also one, or possibly two, other Giant Sloths, a Deer, and possibly an Elephas. There are other remains which I cannot name, even conjecturally.

Of the Mastodon we have two teeth (one badly broken). Here also I place an atlas and a number of other vertebræ; but part or all of these may belong to Elephas. I was shown a tooth of that genus, said to have been found in this shaft. All these remains indicate an animal about 8 or 10 feet high.

To the Giant Sloth I have referred a fragment of an upper jaw, with an anterior molar in good order; another fragment of upper jaw much broken, with two molars and parts of two others; twenty-five detached teeth, many of them broken; two claw cores, nearly complete; a humerus, broken in two, with fragments of two other humeri; fragments of heads of two femurs; lower end of a tibia, and an astragalus. Here also I would place, very doubtfully, a number of vertebræ, with the visceral face of the body deeply excavated, as if for the lodgment of the aorta, with side channels leading right and left, as if for the passage of lateral branches.

I have referred most of these provisionally to *Mylodon harlanii*, as most of the teeth seem to belong to that species, while the claw cores are too much curved for Megatherium, and not enough curved for

Megalonyx. Some of the teeth, however, seem to belong to a different genus. Some years ago, Capt. Dudley Avery found a claw core, which he sent to the Smithsonian Institution, and which was there pronounced to be that of a Megalonyx. This was found near this spot, and in a deposit of the same age.

Part of the antler of a deer was found in the southeast corner of the excavation; but I am not certain whether it came from the blue clay, or from the much more recent deposit containing human vestiges, which here dips down almost to the level of the salt. In the blue clay, however, near this spot, we found vertebræ resembling those of a very large deer, with four molar teeth of some herbivorous animal, probably a ruminant, whose precise affinities are yet undetermined.

Among the miscellaneous specimens are water-worn fragments of coniferous wood, from the blue clay. These are in perfect preservation. There is also a soft stercoraceous mass, found about the junction of the blue clay and loam, apparently the dung of some large herbivorus animal.

MICROSCOPY.[1]

Preservation of some Marine Animals.—In 1891 there appeared a paper by T. Tullberg, *Ueber Konservierinq v. Evertebraten in ausgedehnten Zustand*, in which a novel use of magnesium sulphate, or Epsom salts, was described. Tullberg was guided in his researches by the *a priori* consideration, that, as sea-water contains several salts in definite proportions, it is probable that marine animals would not contract if the proportion of one of the salts was increased, for the animal is already accustomed to these substances; and, on the other hand, it might have a toxic effect. Experimenting with Actinia, he finds that chloride of sodium has no effect, but with sulphate or chloride of magnesium the Actinian expands its tentacles, and after a certain time does not contract at all when its tentacles are pinched. He lets the Actinian expand in a vessel of sea-water, the quantity being determined so that the percentage of the salt added may be known. He then adds to the vessel a thirty-three per cent solution of magnesium chloride or sulphate until the water contains 1% of the salt. The additon is made slowly but is effected within half an hour, at the end of which time the Actinian is found to be anæsthetized. As a matter of fact only the exterior of the animal loses its sensibility.

It is then necessary to kill the animal which may be done by inundating it with some killing fluid, but in this case partial contraction may take place rendering it unfit for museum purposes. A better method is to kill it by slowly adding a 0·1% solution of chromic acid until the water contains from ·03% to ·05% of the acid. The results of this method are very satisfactory save that there is a decrease in the volume of the animal. Sections of the tentacles showed that the cells were not attacked by the substances employed.

This method was applied successfully to various fresh-water and salt-water invertebrates including various Actinians Holothurian, Turbellarians, Nemertines, Chætopods, Gasteropods, Ciona, etc. etc.

Last summer, through the kindness of Commissioner MacDonald, I had the opportunity of spending a few weeks at the U. S. Fish Commission laboratory at Wood's Hole, Mass., and obtained some interesting results with Epsom salts in the preservation of many of the marine invertebrates of that vicinity. The method of application requires modification in individual cases but a few experiments will usually en-

[1]Edited by C. O. Whitman, University of Chicago.

able one to obtain the desired results and in a much simpler manner than that described by Tullberg. Complete stupification of the organism must be produced, so that when it is removed to a killing fluid, no contraction will take place. Care should be exercised, however, not to carry on the process too slowly as maceration may ensue.

Cœlenterates.—The most beautiful results were obtained with sea-anemones which ordinarily are so difficult to preserve in a well expanded condition. These were allowed to expand in a dish with as little water as possible. Then crystals of magnesium sulphate were placed in the bottom of the dish and allowed to dissolve slowly until a saturated solution was obtained. The process of dissolving may be hastened if necessary by stirring up the water gently from time to time with a pipette. Several hours were required to completely stupify large specimens. When narcotization was complete, a few crystals placed in the mouth of the sea-anemone had no effect but if the process had not gone far enough the lips of the animal would slowly spread open and then would follow sometimes a violent contraction of the whole animal. This method was tried upon *Metridium marginatum*, *Sagartia leucolena* and *Halocampa producta* with excellent results, the tentacles remaining perfectly expanded after the animals had been transferred to Perenyi's fluid, picro-sulphuric acid or formalin. The same method applied to *Astrangea*, *Scyphistoma*, and various hydroids did not give as good results as those obtained with the sea-anemones. The polyps were not equally affected so that only portions of the colonies were perfectly expanded. A large Physalia treated in this way was preserved in 4% formalin with all the tentacles and polyps fully extended.

Echinoderms.—Star-fishes and sea-urchins were killed with the ambulacral feet and pedicellaria well extended, by placing them upon the aboral surface for a short time in a saturated solution of Epsom salts and then transferring them to 4% formalin. The epidermis of the star-fishes, however, was rendered soft and was subsequently easily rubbed off, but this was probably due to the formalin.

Specimens of *Synapta* were readily preserved without any constriction by very slowly and intermittently adding to the water, in which they had been allowed to expand, a saturated solution of $MgSO_4$.

Vermes.—Most annelids when placed in a saturated solution of Epsom salts, in a very short time became perfectly limp and were easily extended upon a glass plate and treated with a fixing reagent. *Balanoglossus*, when taken soon after being collected, was preserved in this manner in nearly a perfect state. It was necessary, however, to keep it in position between the edges of two glass slides when the fix-

ing fluid was applied. Good results were obtained with *Cirratulus, Amphitrite, Nereis, Rhyncobolus, Clymenella* and *Phascolosoma. Phascolosoma* in most cases was killed with tentacles protruded. *Nemertean* worms, when transferred to a killing fluid before being completely narcotized, sometimes protruded their probosces.

Ascidians.—*Molgula* and *Cynthia* were readily killed with siphons open after anæsthetization with magnesium sulphate. In this case it is best to add the saturated solution of sulphate intermittently with a pipette.

Ctenophores.—After considerable experimentation a method for preserving these delicate creatures in a nearly life-like appearance was devised. Formalin alone in solutions of varying strength had been tried without success. It was found necessary to treat the animals with some hardening reagent before placing them in the formalin and the following method seems to be the most successful. To a solution of equal parts of 2% formalin and Perenyi's fluid was added enough common salt (NaCl) to increase the density of the mixture to that of sea-water, i. e., until a Ctenophore placed in it barely floated. This adjustment of the density of the surrounding medium prevented the Ctenophores from collapsing of their own weight. After remaining for about half an hour in this fluid, they were transferred to 4% formalin, the density of which had been increased by the addition of either Epsom salts or common salt so that the Ctenophores again barely floated. Epsom salts is probably better than common salt for increasing the density of the fluid. Some specimens which were preserved in formalin+NaCl began to shrink after a few days, while some (Mnemiopsis) which have been preserved for nearly six months in formalin + $MgSO_4$ are still in excellent condition.

After the Ctenophores have been properly preserved, precaution must be taken in transporting them, for they are easily torn to pieces. If they are placed in bottles filled with fluid of the proper density and the cork so inserted as to leave no air bubbles, this danger is reduced to a minimum.—W. A. Redenbaugh, Dartmouth Coll., Hanover, N. H.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

National Academy of Sciences.—A special stated session of the Academy met on Saturday, February 9th, 1895, in New York City, at Columbia College, to consider the Report of the Committee on Electrical Units. The report was adopted and was ordered to be transmitted to Congress.

Boston Society of Natural History.—January 16.—The following papers were read: Prof. E. S. Morse, "Korean Interviews;" Mr. Percival Lowell, "Korea and the Koreans."

February 20th.—The following paper was read: Prof. Edmund B. Wilson, "Karyokinesis and the Fertilization of the Ovum;" illustrated by stereopticon views photographed directly from the eggs of the sea-urchin (*Toxopneustes variegatus*).

March 6th.—The following papers were read: Mr. L. S. Griswold, "The Geographical History of the Lower Mississippi;" Mr. C. F. Marbut, "Some Features of the Coastal Plain in the Mississippi Embayment;" Mr. Cleveland Abbe, Jr., "Note on Cusped Sand-bars of the Carolina Coast."—Samuel Henshaw, *Secretary.*

The Biological Society of Washington.—February 9th.—The paper of the evening was "Explanation of Immunity from Infectious Diseases," by Surg.-Gen'l George M. Sternberg, U. S. A.

February 23d.—The following communications were made: Prof. Lester F. Ward, "Archetypal Angiosperms;" Prof. F. E. L. Beal, "Food Habits of Woodpeckers;" Mr. F. A. Lucas, "Some Abnormal Feet of Mammals;" Mr. M. B. Waite, "Notes on the Flora of Washington."—Frederic A. Lucas, *Secretary.*

Nova Scotian Institute of Science.—February 11th—The following papers were read: "The Iron Ores of Nictaux N. S., with Notes on the Manufacture of Steel in Nova Scotia," by Edwin Gilpin, Jr., Esq., LL. D., F. G. S., Inspector of Mines; "Geological Notes on the Nictaux Iron Fields," by A. H. MacKay, Esq., LL. D., F. R. S. C., Superintendent of Education.—Harry Piers, *Secretary.*

New York Academy of Sciences. Biological Section.—February 11th, 1895.—The following papers were presented: Dr. Albert Schneider, "The Occurrence and Functions of Rhizobia;" a

discussion of the discovery of the adaptability of rhizobia to other plants than leguminous. Some conclusions based upon investigations carried on at the Illinois experiment station were given to show that it is probable that rhizobia may be so modified as to grow in and upon roots of gramineous plants (ex. Indian corn). Prof. N. L. Britton, "An Undescribed Ranunculus from the Mountains of Virginia;" Dr. J. L. Wortman, "On the So-called Devil's Corkscrews of Nebraska." A visit to the locality during the past summer had enabled him to study many problems in connection with their occurrence, which tend to throw considerable light upon their nature. The formation in which they occur was positively identified as the Loup Fork division of the upper Miocene, which is a true sedimentary deposit. The Daemonelix occurs in a stratum of from 50 to 75 feet in thickness, always standing vertically, and their tops are not confined to any one level. They vary much in size and character, but, so far as observed, always present the spiral twist. The fact that they occur in true sedimentary rocks, that their tops occupy many levels, together with the lack of evidence to show that there was any disturbance of level during the time the sediment was being laid down, was considered to totally disprove the theory that they represent the burrows of animals which has been so extensively held in explanation of their curious nature. The invariable presence of plant-cells, together with other facts, leads to the conclusion that they very probably represent the remains of roots or stems of some gigantic water plant.

"The Excretory System of Clepsine and Nephelis," by Dr. Arnold Graf. The results of H. Bolsius have proved to be erroneous. The different parts of the nephridium are classified as follows: 1. *Infundibulum*, consisting in Nephelis of six bilobed ciliated cells, in *Clepsine* of a peduncle cell, pierced by a ciliated canal, and two bilobed ciliated cells attached to the peduncle. 2. *Receptaculum excretorium* A vesicle which is in open communication with the funnel and in osmotic communication with the following parts of the nephridium. It is similar in both genera, and filled with disintegrating material. 3. *Portio afferentia.* The part of the gland, consisting of a single row of round cells, pierced by a sometimes bifurcated canal, which gives off-branched side canals. Similar in both genera. 4. *Portio glandulosa.* Row of cells, pierced by a smooth canal without side branches of bifurcation. This part is the largest part of the whole organ. Similar in both genera. 5. *Vesicula terminalis.* In *Nephelis*, a vesicle, lined by a ciliated epithelium; in *Clepsine*, a simple pouch of the *epidermis*, without cilia. 6. *Canalis terminalis.* The short canal by which the termi-

nal vesicle communicates with the exterior. Present in *Nephelis.* In *Clepsine* it is equivalent to the terminal vesicle.

The cells formerly called Chloragogencells, should now be called *Excretophores.* A preliminary about these cells has been sent to the "Zoologischer Anzeiger." The investigation had been carried out mainly on living tissues, and every source of error had been eliminated.

—Bashford Dean, *Secretary.*

SCIENTIFIC NEWS.

John A. Ryder, Professor of Histology and Embryology in the School of Biology of the University of Pennsylvania, died on March 26th. He was born in 1852 near Linden in Franklin Co., Pennsylvania, of old "Pennsylvania German" stock, and displayed a strong predilection as a small boy for the study of nature. At school he was persistent in the pursuit of his favorite subject, and took little part in the sports and quarrels of the boys with whom he was associated. His sensitiveness to their criticisms was such that he ran away from school, only to devote himself more fully to study. He came to Philadelphia and was soon deep in microscopic work. At that time the methods of preparation of objects for the microscope were not as well understood as they have since become, and Ryder invented most of the methods which he used in his first researches. His studies of the embryology of fishes led to his appointment on the U. S. Fish Commission, where he published a number of important papers on the embryology of fishes and mollusca, and among the latter, the oyster was an especial object of investigation. In 1886 he was appointed to the position which he held at the time of his death. Professor Ryder was an indefatigable investigator, and his published papers, though numerous, give little idea of his activity. He has left behind him manuscript of considerable importance, which it is to be hoped will be published with the aid of a worthy editor. He was for a considerable time editor of the department of embryology of the American Naturalist.

Besides excellent powers of observation, Professor Ryder had a mind naturally capable of comprehending mechanics. He patented several inventions of economic value. This tendency is to be seen especially in his application of mechanics to the problems of evolution, in which he presented many original ideas. He was a strong supporter of the Neolamarkian school; and he carried this hypothesis into the explanation of histogenesis with more success than any American,

and he had few if any equals in Europe. At the same time he cannot be said to have had a very systematic mind. He was an excellent delineator of natural objects. Personally, he was a most amiable man, and he endeared himself to his colleagues and pupils. He leaves a widow.

Dr. William S. W. Ruschenberger died March 25th, 1895, in his 88th year. He was born in Cumberland County, New Jersey, September 4, 1807. After receiving an academic education in Philadelphia and New York schools, he entered the medical service of the United States navy as a surgeon's mate, August 10, 1826.

His medical tutors were Dr. J. P. Hopkinson and Dr. Nathaniel Chapman, of the Medical Department of the University of Pennsylvania, from which he received the degree of Doctor of Medicine in March, 1830. He was commissioned a surgeon in the navy April 4, 1831, and from 1835 to 1837 was Fleet Surgeon to the East India Squadron, with which he circumnavigated the globe. In 1840-42 Dr. Ruschenberger was attached to the naval rendezvous in Philadelphia. From 1843 he was Superintendent of the United States Naval Hospital at Brooklyn, and during his term of service there organized the Naval Laboratory, for supplying the service with pure drugs. He was again Fleet Surgeon of the East India Squadron from 1847 to 1850, Fleet Surgeon of the Pacific Squadron from 1854 to 1857, and of the Mediterranean Squadron from August, 1860, to July, 1861, having served in the intervals between cruises at Philadelphia.

During the civil war Dr. Ruschenberger was surgeon of the Boston Navy Yard. From 1865 to 1870 he was on duty in Philadelphia. From 1866 to the time of his retirement, September 4, 1869, he was the senior officer in the Medical Corps, and March 3, 1871, he was commissioned Medical Director on the retired list, with the relative rank of Commodore.

Dr. Ruschenberger was for several years President of the Academy of Natural Sciences of Philadelphia. His long service as an officer in the navy did not, however, qualify him for corresponding positions in civil life. His habit of enforcing technical discipline was offset by a courteous and affable bearing. He wrote several books describing his travels, and a primary school-book of Natural History, which was the first one of the kind in the country, and was of considerable service to men now in middle life.

The Laboratory at Cold Spring Harbor.—The laboratory has experienced some difficulty in the past years in properly accommodating

its students with lodging places. For this reason the need of a dormitory has been seriously felt for the last two years. The Wawepex Society has recently decided to erect such a dormitory and this building will be begun and finished during the coming spring, so as to be in condition for use during the coming session of 1895. The attempt will be made to furnish comfortable rooms to students at a very nominal price.—H. W. CONN.

The Biological Survey of Indiana.—Special efforts are now being made to make a Biological Survey of the state, the object being: (1) To ascertain the character and extent of the life of the state. (2) To associate the various workers throughout the state so that they all may labor toward the same end. (3) To stimulate the teachers of biology to encourage in their students the accumulation of material. (4) To secure for the Academy a collection that will illustrate the biology of the state.

Three directors have general charge of this work. Prof. Underwood in charge of the botanical division made a very encouraging report of the work in that field. The other directors made no report.

The Academy took an advance step in arranging matters to ask the state legislature to publish its Proceedings. Heretofore, the Academy has had to meet this expense.

The Spring meeting of the Academy will be held at the Wyandotte Cave in Crawford County.—A. J. BIGNEY, *Asst. Sec.*

Summer Course at the University of Pennsylvania.—The Department of Biology, in the Summer Meeting of 1895, will be under the immediate direction of Dr. William P. Wilson, Professor of Botany in the University of Pennsylvania, and Director of the newly established Philadelphia Museums. The lectures and laboratory work of the courses in the Biological Department have been arranged with a view to the needs of teachers in general, and of the teachers of Philadelphia in particular. They will aim to suggest much new material for study in the school-room, to give information concerning it, the best and most modern methods of using it for nature study, and also such technical training in the use of the microscope, etc., as will enable those who complete the course to continue their work in the University. The lectures in the various courses will be fully illustrated by natural objects, charts, diagrams, and by lantern.

The courses will be elementary, and no special preparation on the part of the student will be pre-supposed. Advanced instruction will

be given for those who are ready for it. There will be lectures and laboratory work amounting to about five and a half hours per day during the entire month.

The laboratories and equipment of the University are placed fully at the disposal of the department, for the use of students. The tuition fee in the Department of Biology is ten dollars, with a special laboratory fee of two dollars. Unusually good facilities are thus afforded at a merely nominal cost.

The instruction will consist of three five-lecture courses in Botany, by Professor Macfarlane, Professor Halsted and Professor Wilson; two five-lecture courses in Zoology, by Professor Cope and Professor Ryder's successor; lectures on special topics by eminent biologists; thirty hours laboratory practice in Biology, and five lectures by Mrs. Wilson on Biology from the standpoint of teachers in the elementary schools.

Among the lectures on special topics are: Professor Liberty H. Bailey, of Cornell University, who will deliver two lectures on "How Garden Varieties Originate: a Study in Evolution;" Professor George L. Goodale, of Harvard University, who will deliver an address before the students of all departments on "The Relations of Certain Plants to Political Economy;" Professor Byron D. Halsted, of Rutgers College, whose lectures are ontlined below, and Professor Charles O. Whitman, of the University of Chicago.

A new scientific society has been organized in the Jardin des Plantes, which will hold its meetings the last Thursday of each month. It is composed of the scientific personel of the Museum and has for an aim to bring about a knowledge and a cordial interest in each other's work. It is thought that the discussion of papers presented to the society from various points of view of specialists, in the different fields of biology, will be both interesting and profitable. (Revue Scientifique, Feb. 1895.)

The Academy of Natural Sciences of Philadelphia have voted the Hayden medal to Professor G. A Daubrée, member of the Académie des Sciences in Paris, and Professor of Mineralogy in the École des Mines. Prof. Daubrée's researches into the intricate causes of crystalline structure are important contributions to scientific knowledge as are also his expositions of experimental geology.

The Belgian Academy of Science in Brussels has offered prizes to the value of six hundred francs for the best treatise on one of the following subjects: (1) Researches on the number of chromosomes, be-

fore fertilization, in an animal or a plant. (2) New researches on the Quaternary flora, especially on peat-mosses. (3) Is there a nucleus in Schizophytes? If so, what is its structure and the mode of its division? The author must give a critical résumé of all work hitherto published on this subject. Treatises should be written in French or Flemish, and sent with motto and sealed name to Chev. Edm. Marchal, Secretary of the Academy, before August 1, 1895.

Erratum to be made in "An Abnormal Pes of Columbia livia," by S. D. Judd, "AMERICAN NATURALIST" Jan. '95. Plate VI. The left of the two upper drawiugs was published by mistake, the right of these two drawings should have been labeled "Fig. 2," The remaining skeleton drawing should have been labeled "Fig. 1." Of the two drawings representing feet in toto, the one to the left of the page should have been labeled "Fig. 4," the other "Fig. 3." Explanation of Figures. For Plate I read Plate VI. For XI read times 1=natural size.

List of Errata in Article, Insanity in Royal Families, American Naturalist, February, 1895.—P. 119, lines 14–15, for more direct read direr; P. 119, line 25, for jealously read jealousy; P. 119, line 33, for May read Mary; P. 120, line 2, for and read in; P. 120, line 34, for the read his; P. 120, line 34, for to, read of; P. 122, line 6, for brother read father; P. 124, line 23, for goes, read exists; P. 129, line 17, leave out comma after at.

Erratum.—In No. 329, May, 1894, on p. 439, first line, read Otto Maas in place of Otto Wass.

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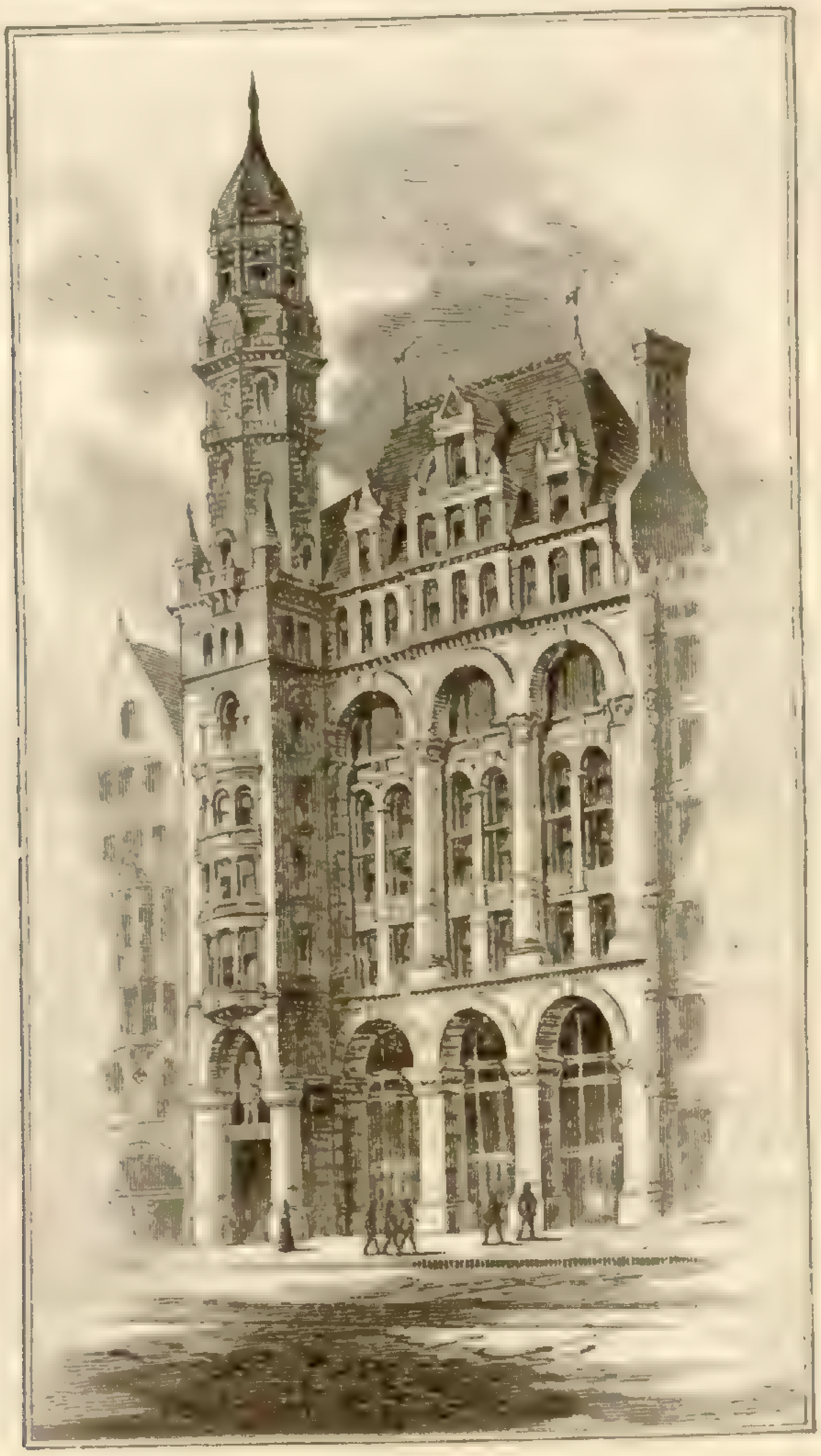

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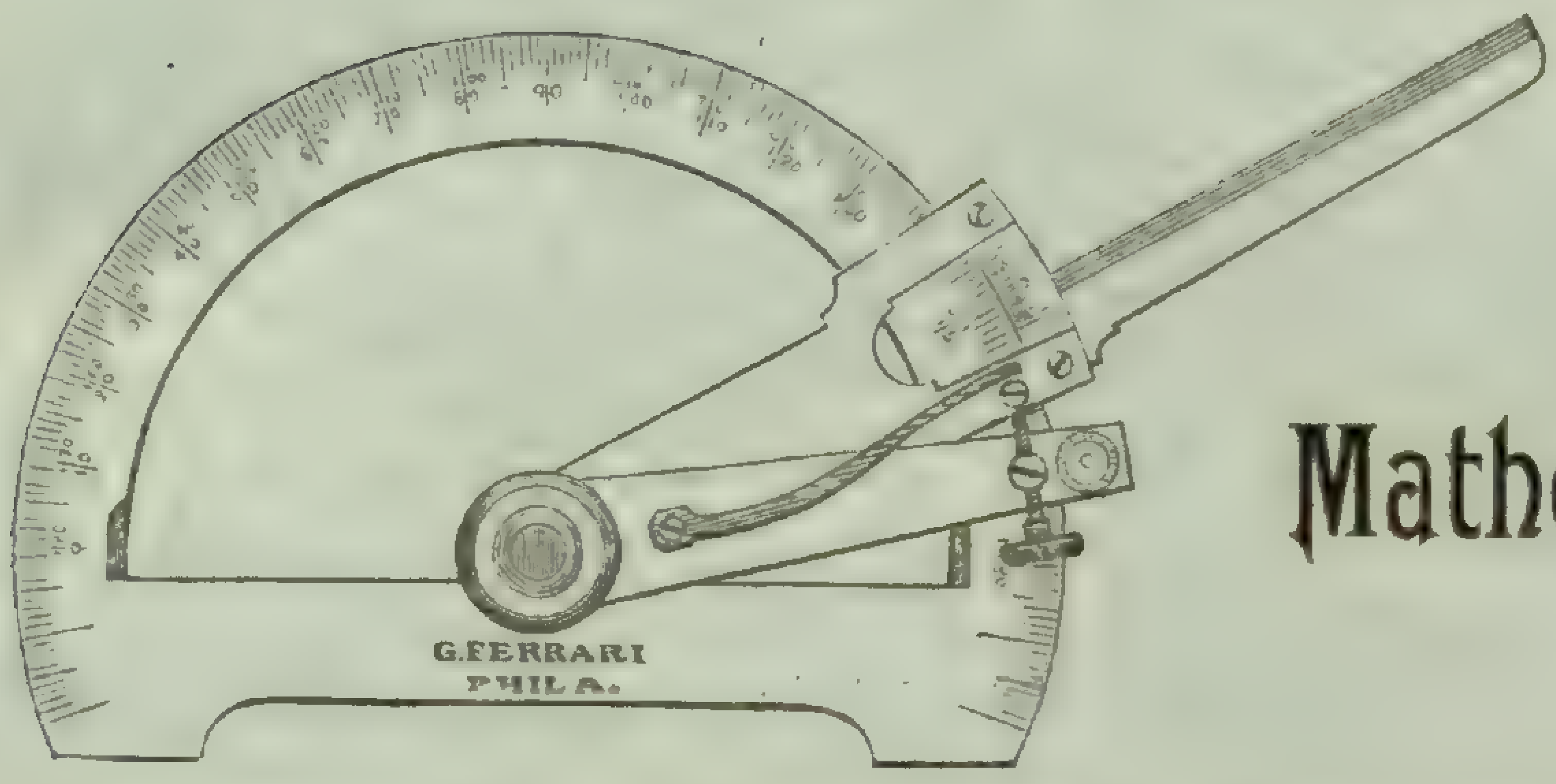

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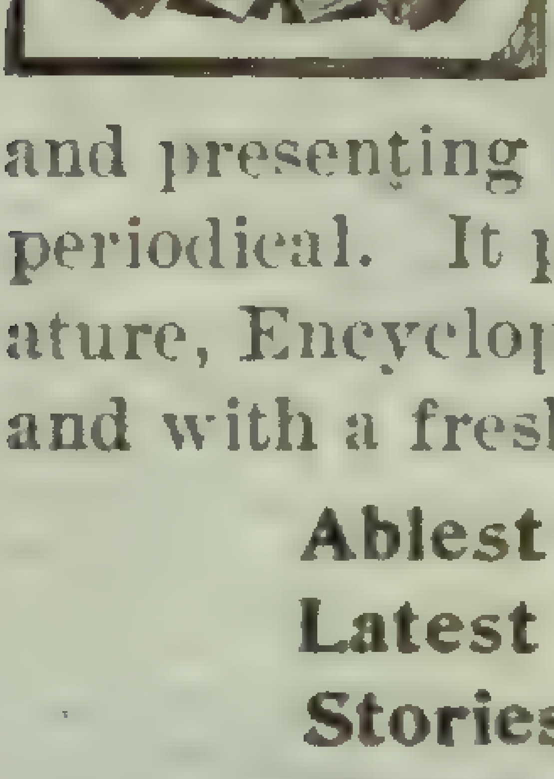

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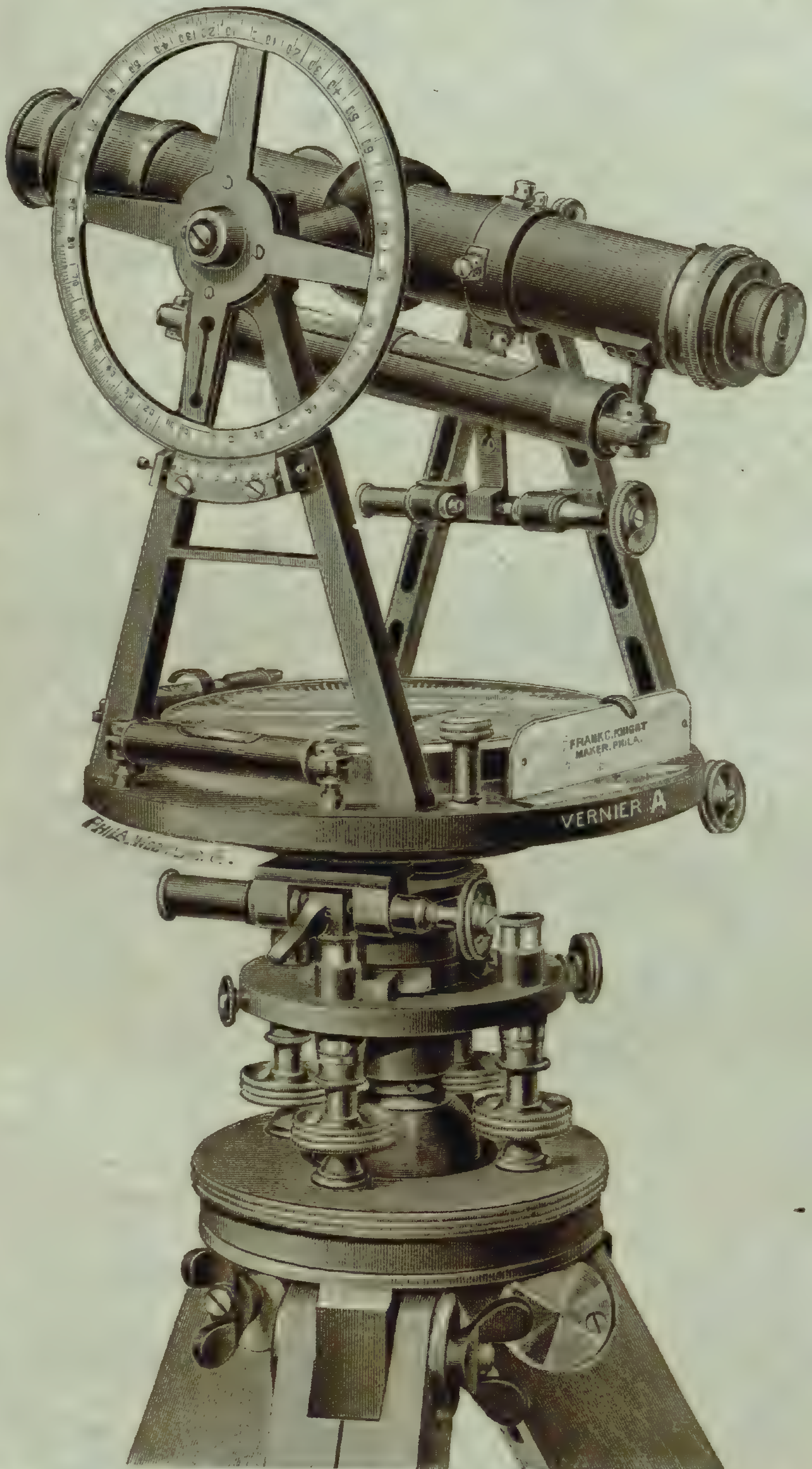

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Vol. XXIX. MAY, 1895. No. 341

CONTENTS.

PAGE.
THE BIRDS OF NEW GUINEA. *G. S. Mead.* . . 409
THE HEREDITARY MECHANISM AND THE SEARCH FOR THE UNKNOWN FACTORS OF EVOLUTION. *Henry Fairfield Osborn.* 418
ON THE PRESENCE OF FLUORINE AS A TEST FOR THE FOSSILIZATION OF ANIMAL BONES. (Continued.) . . . . . *Dr. Thomas Wilson.* 439
THE GENERA OF BRANCHIOSTOMIDAE. *Theodore Gill.* 457
RECENT LITERATURE—Ord's Zoology—The Life of Richard Owen. 459
RECENT BOOKS AND PAMPHLETS. 460
GENERAL NOTES.
Geography and Travels. —The Greenland Scientific Expedition of 1895. 463
Mineralogy—Recent Books—Fletcher, The Optical Indicatrix and the Transmission of Light in Crystals—Hecht, Introduction to the Calculation of Crystals—Behrens, Manual of Microchemical Analysis—Baumhauer, Results of Methods of Etching in Crystallographical Investigation—Czapski, Theory of Optical Instruments—Fuess, Instrument Catalogue—Klockmann, Text-Book of Mineralogy . . . 466
Petrography—Granite Inclusions in Gabbro—The Geology of Pretoria, South Africa—The Gabbro of the Adirondacks—The Dykes of the Thousand Islands—Analcite-Diabases from California—A Quartz-Keratophyre from Wisconsin—Notes 470
Geology and Paleontology—The Lakes of Central Africa—Structure of Triarthrus—Land Animals of the Canadian Paleozoic—The Devonian System of Eastern Pennsylvania and New York—The English Tarns—The Loess of Northern China—Geological News . . . 474
Botany—Notes on Mexican Lichens, I—The Simultaneous Origin of Similar (or identical) Varieties from Different Stock—Some Features of the Native Vegetation of Nebraska—The Division of Agrostology—Gray's Field, Forest, and Garden Botany. 480
Zoology—Web-Spinning Spiders—Fishes of the Northwest—Queer Misfortunes of Birds—The Cotton-Tail Rabbit—Zoological News, Mollusca—Crustacea—Agnatha—Pisces—Reptilia—Aves—Mammalia 490
Entomology—The Cabbage Root Maggot. (Illustrated)—Ohio Dragonflies—A Unique Journal—Loss by Fire—Male Reproductive Organs of Beetles—Lamp Chimneys for Breeding Cages—The Name of the Southern or Splenic Cattle-Fever Parasite 495
Embryology—Ascaris Eggs and Temperature—Isolated Blastomeres in Ascidians—Frog's Eggs in Salt Solution—Stimuli in Embryology. 499
Psychology.—Psychical Research 503
Archeology and Ethnology—Notes on Yucatan—The Potters' Wheel in Yucatan 507
Microscopy—Cytotropism of Cleavage Cells . 511
PROCEEDINGS OF SCIENTIFIC SOCIETIES. 513
SCIENTIFIC NEWS. 514

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AMERICAN NATURALIST

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THE BIRDS OF NEW GUINEA.

BY G. S. MEAD.

(*Continued from page* 9).

No one is more deserving of the honor of having a bird of paradise named after him than Mr. Wallace. Such an honor, it is true, is not an extraordinary one in his case, being scarcely more than the customary recognition of a first discovery, but at all events it serves to remind us how closely he has identified himself with a beautiful family of birds, while his still greater labors for knowledge have already secured the reward of preëminence in the field of science where excellence is not always remembered by the world at large.

In "The Malay Archipelago," the author has told of his accidental discovery in the island of Batchian of a new species which was called from his name *Semioptera wallacei.* This was as along ago as 1858, and in all the intervening years no one has succeeded in making the bird a familiar inmate of museums. It is not of remarkable beauty, although its appearance is, in one respect at least, strangely peculiar, viz., in that which gives it the name Standard-wing. This curious formation is not a wing at all, but two flexible feathers springing from either shoulder, six inches in length and quite distinct from every other part of the plumage. As they stand out, swaying slightly to every movement, they look not unlike

four narrow ribbons of unequal width, that had somehow become entangled on the back of the bird. They are of a whitish color, a pleasing contrast to the sober hue of the upper parts, and especially to the vivid greens and emeralds of the breast and throat.

A two-fold shield extends its points several inches on either side after the fashion of the Superb bird of paradise. This targe sparkles with radiance, but aside from it and a less observed gleam of violet on the head, the Standard-wing is comparatively plain; perhaps no other species wears such a quaker garb. Short, recurved feathers impinging upon the bill, cover the forehead. The tail is stiff and square, and nearly overlapped by the wings. Both have white shafted feathers. Altogether the bird is destitute of the rich coloration of others of its tribe, save in the deeply forked pectoral shield, which, however, in its intense, sparkling lustre, makes partial amends. This is contrasted with the uniform drab of the rest of the plumage with striking effect. Herein lies the beauty of the *Semioptera*. Its oddity rests in the extraordinary standard-wing plumes. For about half their length, these widen out oar-like in white feathers, the remaining part up to the body consisting of the bare quill-shaft. The bird is almost a foot in length, the native of Gilolo being larger than that from Batchian and more strongly marked. It is remarkable, as Mr. Wallace points out in his admirable account, that this is the only species of paradise birds known beyond the borders of Papua and Northern Australia. Its habits are active, and its dissonant voice keeps pace with its movements. It may frequently be seen flitting rapidly among low tree-branches or clinging to the boughs. The female is in plain colors with scarcely a gloss on her feathers, excepting the crown, and is entirely without shield, alar plumes or green glaze.

Among the true birds of paradise, Mr. Wallace classes *Diphyllodes wilsonii* and calls it a distinct species, "still more rare and beautiful" than the Magnificent, which it resembles in size and plumage. This bird, strangely enough, was first 'discovered' in Philadelphia, where, however, it must be con-

fessed, it is not native. It has been rediscovered since in Waigiou and Batanta. The anomalous feature characterizing the Red Magnificent or Schlegel's Paradise bird—a better name—as it is sometimes called, and setting it entirely apart from its relations, is its bald head. This might seem a sad blemish to beauty, but as if to atone for a caprice, nature has painted the spot a deep blue and intersected it with lines of dark feathers. The wings, back, and lesser fringe are blood-red, hence the specific term, with dark shadings; the mantle springing from the neck is a bright yellow, while the breast reveals emerald and all its reflections in its dark depths. These are the predominant tones, but they emit and shade off into a hundred transitory hues, the metallic surface changing fitfully with every changing light. Around this breast shield runs a narrow fringe of dark, thin filmy plumes, cut like a pattern with waving edges of an old-gold color. The tail is brown, squared but with rounded corners; from the rump two centre feathers much elongated and very narrow project, cross each other twice and then become involved in an incomplete circle. These curious appendages are much shorter than those of the Magnificent Paradise-bird, but are curved with even greater elaboration, though lacking the bold, sweeping lines of that fine species.

The bird is a small one, not much over seven inches in length; the female equals her mate in size, but, of course, is deficient in every other respect with this exception, that she is partially bald. Her dress is a uniform brown and yellow, with gray speckled breast.

In taking leave, for the present, of the birds of paradise, mention may be made of the Paradise Oriole, *Sericulus aureus*, a separate genus but bearing certain marks of a character similar to the group already considered. Mr. Stone records the bird as found in southern New Guinea, although he does not appear to have collected it, while Mr. Wallace ascribes it to Salawatti as well, noting at the same time that it is excessively rare. In general coloring it is like our Baltimore Oriole, with an admixture of the flaming Scarlet Tanager (being still more in the tone of orange, like the Cock-of-the-rock)

a brilliant contrasted gold and black, the brighter hue predominating. Here the resemblance ceases, and affinity with the *Paradisea* is suggested in the long thickly folded plumes of a deep shining yellow, running in rippling lines of light down the neck and back, and forming a large dorsal shield or mantle. Of the same fiery orange-red are the longer side plumes. A lighter tint intermingled with black prevails on the rump, tail coverts and scapulars. Jet black marks the throat and the side face enclosing the eye. An inch wide streak of the same runs along the side of the body as far as the tail. The under parts are an orange-yellow. It will be seen, therefore, that *Xanthomelus aureus,* as he is also termed, is a very showy fellow. To add to his port, he is adorned with an erectile crest like that of the Blue-jay, excepting in color. In size he is about the same as that denizen of our forests. He carries himself too with as much alertness and can be as noisy on occasions, though ordinarily he is incurious and evasive. He is thought to build some kind of a bower, but this is not positively known. His note is clear and resonant. The female is a very pale reflection of her beautiful mate.[1]

Allusion has been made several times in these pages to Mr. Octavius Stone. This gentleman visited Southeastern New Guinea twice, and twenty years ago his collection of birds was, perhaps, the most considerable that had been gathered up to that time. He secured 116 species, among them some either entirely unknown or never seen before in England. Among these was a new Catbird, named from its discoverer *Aeluroedus stonii.* This interesting little stranger may claim affiliation with the Bower birds, and through them with the *Paradiseidae.* It does not, however, construct a bower. In size it is smaller than *Aeluroedus buccoides* (Temm.) a species more common in New Guinea, especially in the northwestern part. The length is between nine and ten inches. As one takes up the

[1] *Oriolus aureus* and *xanthogaster* (Vide, p. 393, Vol. XXVIII, American Naturalist) are probably one and the same, the latter being now regarded as the young of this lovely bird which is burdened with many other synonyms besides those already mentioned.

skin of this bird, he might deem it that of some small parrot, the thick, white, curved beak assisting that impression. The upper parts are a lively green, growing dark on the extremities of the wings and tail; a touch of blue and yellow appears here and there. The head is a dull black, the throat a spotted black and white. Yellow is the prevailing color beneath, speckled with black and green. These tints cover the nape of the neck, the black in streaks running like so many short strings of beads on a yellow ground. White shows on the throat and side face dotted with dark spots. The tail is short and square. The same terms apply to the form of the bird. The female is of the same size and figure.

Aeluroedus buccoides or Barbet-like cat bird of Western New Guinea has the spots on the throat and under parts much larger than those on the preceding species. The head is olive-brown, the wing coverts a uniform green; length ten inches.

In *Aeluroedus melanocephalus* we must first notice its specific characteristic—the black head—in which, however, it is not singular, *arfakianus* being marked in like fashion. It has green wing-coverts, dark olive-brown under parts, black-tipped feathers on the throat, the ground color being white, the black running only as a narrow stripe or figure.

Every one has heard of the Bower-bird—*Chlamydera*—who constructs a play-ground or garden of delight, adorning it with all sorts of attractive objects either for his own whimsical purposes or to please his mate. The bower is some little distance through, perhaps thirty inches along the ground, and is composed of short twigs and sticks so placed as to form a half-roofed tunnel. Here the bird passes much of his time, diverts his mate by adding to their resort or by showing the gay material he has picked up, and in various ways manifests his appreciation of his own ingenious devices. He is a plain fellow in his own dress, though his taste is for the gaudy and meretricious; his size too, is small in proportion to the Castle of Indolence he rears, for this is no nest—this retreat of his, but a pleasure-house, a place of retirement, quiet amusement, or rollicking sport. His nursery is a different thing altogether, and is placed elsewhere. In his bower he

gives his fancy full swing; he brings hither to garnish it every bright article he can discover, and lays a considerable territory under tribute to minister to his beloved habit, and so prodigal is he of his acquired treasures that the approaches to his singular abode are strewn with spoils. Nothing seems to come amiss, hence he is as eager to possess himself of old bones, shells, stones, and all kinds of miscellanea, as bits of metal, flowers, leaves, dropped feathers, etc., although as a rule, glittering objects prevail, obviously collected for decorative purposes. It is apparent that with so much evidence in plain sight, the little builder could not well conceal his structure, nor indeed was it the probable intention to do so; it was far easier to hide the real nest, and this has been done so effectually that the most persevering efforts towards discovery have gone unrewarded. It is not likely, however, that arbor and nest are very far apart.

The *Chlamydera cerviniventris* or Fawn-breasted Bower-bird is enough like the common female robin of this country to be mistaken for her. The bird is very plain throughout, the nearest approach to brightness, and that but slight, being on the breast and abdomen, where a brownish-yellow tinge occurs. The buff throat is streaked with dull yellow. The upper parts are uniformly drab or slate. It is rather longer than our robin—about twelve inches—with tail and wings extended more than strict proportions would permit. The bill is short and black, eyes are dark, legs and feet black. The male is said to sing sweetly, thus adding another accomplishment to his faculty of pleasing his mate as well as himself.

Another Bower-bird of New Guinea is the Gardener—*Amblyornis inornatus*—who builds his hut or arbor of a triangular shape, set back against the trunk of a tree; in front he scatters the usual assortment of shining, smooth, and curious objects together with perishable substances, such as small plants, flowers, insects, fruit and fungi, removing them carefully when they become offensive or timeworn. This little virtuoso is plain in color, a yellowish-red predominating, and in size and general appearance not unlike a large Brown Thrasher. He seems always busy and, indeed, must be, for the nature of his

work requires unflagging diligence, but the time of greatest activity probably is during the pairing season.

The best authorities describe the cabin of the Gardener as built around the central stem of some bush, or as enclosing a cluster of shoots; in front the garden is placed, and is set out with that strangely rational, though fantastic system of horticulture that has gained the bird its name. If there is no growth in the garden, we may infer that this branch of cultivation formed no part of the grand design; the results were all that was sought and these were to be always above ground. These birds have been classified by some naturalists with the *Paradisea*, though nothing in their appearance, habits or song (they are said to sing sweetly) seems to bear out such assignment.

This curious and fascinating bird is very local in its range, being confined so far as known to the Arfak Mountains in the northwest of New Guinea. It is only of recent years that it has been studied by scientifically; Mr. Wallace knew nothing of it nor have naturalists since his visit to the great island added much to our knowledge. Dr. Becceari was the first to introduce the Gardener to the world, and his graphic account of the abode of the little artificer has not been surpased in merit nor greatly amplified in details by subsequent investigators. The Italian traveller, as in a picture, shows the hut or cabin close upon a small, flower besprinkled meadow. It is built around the stem of a little tree as thick and tall as an ordinary walking-stick. The materials used are moss chiefly, and form a structure about three feet in diameter. In shape the nest is conical, reminding one irresistibly in its whole appearance of the head covering Robinson Crusoe is usually represented as wearing. Inside is a little gallery or runway built along the walls. The garden is arranged before the hut decked out as we have seen. Amblyornis—simple in attire and coloring as his specific name indicates—is now a favorite illustration with theorists of the adaptation of animate life to its surroundings. Certainly its dun and sober clothing assimilates easily with the tones of soil and vegetation around. Its home

too with all its adornments harmonizes with, indeed, forms a part of the gay green wood.

A very interesting little group of passerine birds belonging to the family of *Prionopidae* are the *Rectes*, of which there are several species common to New Guinea and the adjacent islands. Near his camp at Narinuma on the southern side of the mainland, Mr. Denton first saw "brown birds with black heads" sitting close together and keeping up a constant whistle, very soft and prolonged. The sound he describes as not unlike a steamboat whistle a great distance away. It seemed almost impossible for a small bird to produce such a sound. All travellers have met one or another of the several varieties in different parts of the island. Probably Mr. Denton's bird was *Rectes cirrhocephalus* or *dichrous*, if these are not one and the same bird. The former, indeed both species, while not brilliantly clad, possesses a singularly rich golden-brown dress contrasted with the jet black of the head, wings and tail. When the bird flies through the sunshine this warm plumage lights up with wonderful effect. Then the entire body is displayed, and is seen both above and below to be full of all the tints from maroon to orange. Black again appears on the throat extending well down on the breast. The bill is also black. The tail, black above and below, is long and narrow. A whitish feather might be traced on the inner wing of the skins examined. The female is almost the counterpart of the male, the points of difference being so slight as to make identification of the sex in life no easy matter. The bird is between nine and ten inches in length.

A somewhat larger species is to be noticed in *Rectes uropygialis*, the Rufous and black wood Shrike, whose favored habitat is the little island of Mysol, lying a considerable distance to the west of New Guinea. In this instance, similar colors and a similar disposition of colors prevail, with the black, however, running a little farther upon the body. The head is ruffled by a longitudinal crest of black feathers as in the preceding.

But in place of the ruddy glow of the foregoing, we have in *Rectes cerviniventris*, or Fawn-breasted Wood Shrike a subdued olive or even ashy gray for the general coloring. On

tail, wings and under parts we observe a stain of brown and dull red, paling here and there into mauve or ash. This little bird, not much more than eight inches long, nearly half of which is tail, is a native of Waigiou, but probably he extends his wanderings throughout most of Papua. A crest marks this species also.

THE HEREDITARY MECHANISM AND THE SEARCH FOR THE UNKNOWN FACTORS OF EVOLUTION.[1]

By Henry Fairfield Osborn.

" Disprove Lamarck's principle and we must assume that there is some third factor in Evolution of which we are now ignorant."[2]

Chief among the unknown factors of evolution are the relations which subsist between the various stages of development and the environment.

A study of the recent discussion in the *Contemporary Review* between Spencer and Weismann leads to the conclusion that neither of these acknowledged leaders of biological thought supports his position upon inductive evidence. Each displays his main force in destructive criticism of his opponent; neither presents his case constructively in such a manner as to carry conviction either to his opponent or to others. In short, beneath the surface of fine controversial style we discern these leaders respectively maintaining as finally established, theories which are less grounded upon fact than upon the logical improbabilities of rival theories. Such a conclusion is deeply significant; to my mind it marks a turning point in the history of speculation, for certainly we shall not arrest research with any evolution factor grounded upon logic rather than upon inductive demonstration. A retrograde chapter in the history of science would open if we should do so and should accept as established, laws which rest so largely upon negative reasoning.

The growing sentiment of the necessity of induction and of inductive evidence is the least conspicuous, but really the most

[1] From the "Biological Lectures" of Marine Biological Laboratory, Woods Holl. This lecture is mainly from an article published by the author, in Merkel u. Bonnet: *Ergebnisse fur Anatomie und Entwickelungsgeschichte*, Freiburg, 1894, and partly from a paper before the Biological Section of the British Association for the Advancement of Science: Certain Principles of Progressively Adaptive Variation observed in Fossil Series. *Nature*, August 30, 1894.

[2] Osborn: Are Acquired Variations Inherited? Address before the American Society of Naturalists. *Amer. Naturalist*, February, 1891.

important and lasting outcome of this prolonged discussion. Weismann is the real initiator of this outcoming movement although it has taken a radical direction he neither foresaw nor advocated, for his position is eminently conservative. In fact his first permanent service to Biology is his demand for direct evidence of the Lamarckian principle, which has led to the counter-demand for such evidence of his own Selection principle, which by his own showing, and still more by his own admission in this discussion with Spencer, he is unable to meet. His second permanent service, as Professor E. B. Wilson reminds the writer, is that he has brought into the foreground the relation between the hereditary mechanism and evolution.

What have we gained in the controversy of the past decade unless it is closer thinking and this keener appreciation of the necessity for more observation? We carry forth, perhaps, some new and useful working hypotheses as to possible modes of evolution, and a fuller realization of the immense difficulties of the heredity problem—but these are only indirect gains. It is a direct gain that these negative results have led a minority of biologists into a total reaction from speculation and into a generally agnostic temper towards modern theories which is far more healthy and hopeful than the confident spirit of the majority upon either the Neo-Lamarckian or the Neo-Darwinian side. There is no note of progress in the dogmatic assertion that the question is established either as Spencer or as Weismann would have it, unless this assertion can be backed up by proof, and by whom can proof be presented if not by these masters of the subject? The conviction we all reach when we sift wheat from chaff, and bring together from all sources phenomena of different kinds and seek to discern what the exact bearings of these phenomena are, is that we are still on the threshold of the evolution problem, and that the secret is largely tied up with that of vital phenomena in general.

The very wide and positive differences of opinion which prevail are attributable largely to the unnatural divorce of the different branches of biology, to our extreme modern specialization, to our lack of eclecticism in biology. We begin to grasp the magnitude of the problem only when side by side

with field and laboratory data are placed paleontological data, as well as anthropological, including the unique facts of human variation and the laws of human inheritance. For in modern embryology certainly the most brilliant discovery is that the physical basis of all inheritance is the same—and growing out of this is the high probability that the laws of heredity are the same in the whole organic world, with no barriers between protozoa and metazoa, or between animals and plants. Both Weismann and Spencer show themselves blind to this nexus of fundamental uniformity when they draw certain lines of division in inheritance where none exist in the visible hereditary mechanism of chromatin and archoplasm. With these discoveries in mind does not Weismann appear as much afield when he maintains that the inheritance of acquired characters is a declining principle in the ascent of life, as Spencer when he maintains that it is a rising principle in the ascent of life?

The first step then towards progress is the straightforward confession of the limits of our knowledge and of our present failure to base either Lamarckism or Neo-Darwinism as universal principles upon induction. The second is the recognition that all our thinking still centers around the five working hypotheses which have thus far been proposed; namely, those of Buffon, Lamarck, St. Hilaire, Darwin, and Nägeli. Modern criticism has highly differentiated, but not essentially altered these hypothetical factors since they were originally conceived. Darwin's 'survival of the fittest' we may alone regard as absolutely demonstrated as a real factor, without committing ourselves as to the 'origin of fitness.' The third step is to recognize that there may be an unknown factor or factors which will cause quite as great surprise as Darwin's. The feeling that there is such first came to the writer in 1890 in considering the want of an explanation for the definite and apparently purposeful character of certain variations.[3] Since then a similar feeling has been voiced by Romanes and others, and quite lately by Scott;[4] but the most extreme expression

[3] *Op. cit.*, 1891.

[4] On Variations and Mutations. *Am. Jour. Sc.*, November, 1894.

of it has recently come from Driesch[5] in his implication that there is a factor not only unknown but unknowable!

Theoretically neither of these five hypotheses of the day excludes the others. They may all coöperate. The role which each plays, or the fate of each in the history of speculation largely or wholly depends upon the solution of the problem of the transmission or non-transmission of acquired variations and after all that has been written on this question this must be regarded by every impartial observer as still an open one.

We are far from finally testing or dismissing these old factors, but the reaction from speculation upon them is in itself a silent admission that we must reach out for some unknown quantity. It such does exist there is little hope that we shall discover it except by the most laborious research; and while we may predict that conclusive evidence of its existence will be found in morphology, it is safe to add that the fortunate discoverer will be a physiologist.

The Analysis of Variation.

After this introductory survey let us consider as another outcome of the controversy that Variation and the related branch of research, Experimental Evolution, are now in the foreground as the most important and hopeful of the many channels into which the inductive tests of known or unknown factors may be turned. Let us make an honorable exception of those reactionists, such as Bateson[6] and Weldon, who have instituted an exact investigation into the laws of Variation.

How shall the study of Variation be carried on? I totally differ at the outset from Bateson in the standpoint taken in the introduction of his work, that the best method of starting such an investigation is in discarding the analysis which rests upon the experience as well as the more or less speculative basis of past research. There is little clear insight to be gained by considering variations *en masse*, and in this lecture I shall put forth some reasons why this is the case as well as some prin-

[5] Analytische Theorie der Organischen Entwickelung. Leipsic, 1894.

[6] W. Bateson: Materials for the Study of Variation, London, 1894.

ciples which seems to be preliminary to an intelligent collection and arrangement of facts, upon the ground that a mere catalogue of facts will have no result. Variation is to be regarded as one of the two modes or expressions of Heredity, or as the exponent of old hereditary forces developing under new or unstable conditions. It stands in contrast not with Heredity, which includes it, but with Repetition as the exponent of old forces developing under old or stable conditions. Nägeli ten years ago[7] laid stress upon this, as have latterly Weismann, Bateson, Hurst,[8] and others. Nevertheless it is still widely misconceived. Hurst even regards Variation as the oldest phenomenon—an error in the other extreme, for they are rather coincident phenomena—representing the stability or instability of development. The broadest analysis we can make is that variations are divided by three planes—the plane of *time*, the plane of *cause*, and the plane of *fitness*. This raises the three problems to be solved regarding each variation; when did the variation originate? what caused it to originate? is it or is it not adaptive?

The student of heredity, in connection with these three planes of analysis, has then to consider the modes of heredity as complementary or interacting, for as soon as a 'variation' recurs in several generations it is practically a 'repetition,' and the repetition principle is a frequent source of apparent but not real variation or departure in the offspring from parental or race type. This relation becomes clear when we consider variations in man as seen in Anatomy and in Galton's studies of inheritance and as expressed in the following table:—

[7] "Vererbung und Veränderung sind, wenn sie nach dem wahren Wesen der Organismen bestimmt werden, nur scheinbare Gegensätze." *Theorie der Abstammungslehre*, p. 541.

[8] Biological Theories. I, The Nature of Heredity. *Natural Science*, vol. I, No. 7, September, 1892. II, The Evolution of Heredity. *Natural Science*, vol. I, No, 8, October, 1892

HEREDITY.

Repetition.	*Variation.*	
A. Retrogressive to present and past type.	*A.* Neutral both as regards present or future type. Including anomalies and abnormalities which are purely individual phenomena not in the path of evolution.	*B.* Progressive to future type.
(*a*) Repetition of parental type.		(*a*) Ontogenic variation from parental type in one or more characters.
(*b*) Regression to present race type usually in several characters (=Variation from present *parental* type).		(*b*) Ontogenic variation from present race in several characters (=a new sub-type).
(*c*) Reversion to past race type, usually in few or single characters (=Variation from present *race* type).		(*c*) Phylogenic or constant variation towards future race type, in one or more characters, constituting a new 'Variety' (=Repetition of parental type).
Palingenic Variation.		*Cenogenic Variation.*

The most profound gap in time is between 'palingenic variations,' springing from the past history of the individual, and 'cenogenic variations,' which have to do only with present and future history. The former embraces more than reversion. This table gives us only our first impression of this plane of time so lightly regarded by Bateson, if indeed discrimination is possible among data of the kind he has collected. The distinctive import of human anatomy[9] is that a comparison of the past and present habits of the race, or of the uses to which bones and muscles have been and are now being put, opens a possible analysis of variations both as regards their time of origin and as regards their fitness to past, present, or future uses; it is thus an inexhaustible mine for the philosophical study of variation—of which only the upper levels have been worked.[10] Beside the human organism there is no other within

[9] R. Wiedersheim: Bau des Menschen als Zeugniss seiner Vergangenheit. Freiburg, 1887.

[10] H. F. Osborn: Present Problems in Evolution and Heredity. The Cartwright Lectures. I. The Contemporary Evolution of Man, etc. Wm. Wood & Co., New York, 1891.

our reach admitting such exact analysis of variation in the planes of time and fitness. When, again, we connect human anatomy as a field for the study of Variation with Galton's researches, although his emphasis has been chiefly upon the laws of Repetition, we begin to appreciate the far-reaching importance of his inductions. In contrast with those of Weismann they are based upon facts and will stand. In the first volume of these Marine Biological Laboratory lectures I went into some detail to show how Galton bears upon the modern evolution problem, so that here I may briefly recapitulate. He demonstrates two principles: First, that there must be some strong progressive variational tendency in organisms to offset the strongly retrogressive principle of Repetition wherever the neutralizing or swamping effect of natural inter-breeding is in force, as it virtually is for most anatomical characters of the human race. Second, he shows what has not been pointed out in this connection before, that in natural inter-breeding ontogenic or individual variations are conspicuous but in the main temporary, while there is a strong undercurrent of phylogenic variations relatively inconspicuous and permanent. Other evidence supporting this latter principle comes out as we proceed.

What is the value of a distinction between *ontogenic* and *phylogenic* variations? It is this: it sets forth the widely neglected initial problem of the *time of origin of a variation in the life history of the individual.* This is the first step in experimentation upon variation, not only as it will afford crucial evidence as to the factors of Buffon, Lamarck, and of St. Hilaire, which hinge upon the inheritance of acquired variations, but in the coming days of exact research upon Variation in general. Let *ontogenic variation*—a term first used by Brooks, I believe, although I cannot point out where—include all deviations from type which have their cause in any stage of individual development. We are now beginning to fully recognize that the causes of certain kinds of variation actually can be traced to external influences upon certain stages of growth or ontogeny, and that it will be possible ultimately to determine these stages when this matter of time is established

by experiment. Let *phylogenic variation*—a term first used by Nägeli[11]—include those departures from type which have become constant hereditary characters in certain phyletic series or even in a few generations. While all phylogenic variations must originate in ontogeny or in some stage of individual development, certainly a very small proportion of the innumerable ontogenic variations which we find in the examination or measurement of any adult individual ever become phylogenic, or constitute more than ripples upon the surface of a tide.

This vital distinction has not been regarded hitherto. The statistics of variation, as compiled by Darwin and lately by Wallace, Weldon, Bateson, and others, do not take into account that among phylogenic variations are others purely ontogenic springing up and disappearing during individual life, owing to causes connected solely with the disturbance of the typical action of the hereditary mechanism during ontogeny. In other words, these writers have without discrimination based upon variations, which may be largely or wholly ontogenic and temporary, the important principles of 'Fortuitous Variation' of Darwin and of 'Discontinuous Variation' of Bateson, whereas it is only the laws of phylogenic variation which are of real bearing upon the problem of evolution. Take as an illustration of this false method the wing measurements of birds given by Wallace. Why may not these be largely cases of purely ontogenic variation due to influences of life habit or to some purely temporary disturbance of the hereditary basis? Above all others, the Neo-Darwinians must reconsider their principle of 'fortuitous variation' which is an induction from data of miscellaneous ontogenic and phylogenic variations, because Neo-Darwinism is essentially and exclusively a theory of the survival of favorable phylogenic variations.

[11] Die Veränderung, die gewöhnlich der Vererbung gegenüber gestellt wird, steht nicht im Gegensatz zu dieser, sondern zur Constanz. In diesem Sinne heisst eine Veränderung constant, wenn das Gewonnene dauernd behalten, und vergänglich, wenn es bald wieder preisgegeben wird. Die constante oder die *phylogenetische Veränderung* . . . ist eigentlich nichts anderes als die Constitutionsänderung des Idioplasmas. *Theorie der Abstammungslehre*, p. 277.

One aspect of the variation problem of to-day may, therefore, be stated thus: What is the cause, nature, and extent of ontogenic variations in different stages of development, and under what circumstances do ontogenic variation become phylogenic?

This brings us to an analysis of ontogenic variations in the *plane of time* as provisionally expressed in the following table:—

Origin of Variations during Life History.

A. Ontogenic Variations.	*Theories of Causation.*
(*a*) *Gonagenic, i. e.*, those arising in the germ-cells, including the 'Blastogenic' in part of Weismann, the 'Primary Variations' of Emery.	Theoretically connected with pathological, nutritive chemico-physical, nervous influences, as implied by Kölliker and others, including the doubtful phenomena of Xenia and Telegony.
(*b*) *Gamogenic, i. e.*, those arising during maturation and fertilization, including the 'Blastogenic' in part of Weismann, 'Secondary,' or 'Weismannian variations' of Emery.	Theoretically connected with influences named above, also with the combination of diverse ancestral characters, 'Amphimixis' of Weismann.
(*c*) *Embryogenic, i. e.*, those occurring during early cell division, including the 'Blastogenic' and 'Somatogenic' in part of Weismann.	Theoretically connected with extensive anomalies due to abnormal segmentation and other causes, as observed in the mechanical embryology of Roux, Driesch, Wilson, and others.
(*d*) *Somatogenic, i. e.*, those occurring during larval and later development after the formation of the germ-cells.	Connected with reactions between the hereditary development forces of the individual and the environment.

B. Phylogenic Variations.

Variations from type originating in any of the above stages which become hereditary.

The above table illustrates limits which certainly should not be sharply drawn between the successive stages of ontogeny, although intermediate focal points of real distinction must exist. The four terms proposed are not in the sense of the 'blastogenic' and 'somatogenic' of Weismann, for there is no implication of his *petitio principi*, namely, of the separation of the hereditary substance or specific germ-plasm from the body-cells. Even before somatogenic separation has taken

place we have little or no reason to believe that all the blastogenic, gonagenic, or gamogenic variations which may have arisen from various causes will become phylogenic.

If we carry our analysis into the *'plane of fitness'* the first point which arises is whether variations are *normal,* including both cenogenic and palingenic variations, or *abnormal,* including teratological and other malformations. The terms 'fortuitous' and 'indefinite' as opposed to 'determinate' and 'definite' may be used apart from any theory, although they have sprung up as distinguishing two opposed views as to the principles of variation. 'Fortuity' strictly implies variation round an average mean, while 'definite' is not the necessary equivalent of adaptive, but simply implies progressive or phylogenic variation in one direction which Waagen and Scott have termed "Mutation." Bateson's terms 'Continuous' and 'Discontinuous' are useful as distinguishing gradual from sudden ontogenic variation.

In general our five working hypotheses as to the factors of evolution are theoretically related to the time stages of Variation as seen in the following table :—

Buffon's	*Ontogenic*	
Buffon's	*a* Gonagenic	
Buffon's	*b* Gamogenic	
Buffon's	*c* Embryogenic	St. Hilaire's
Buffon's	*d* Somatogenic	Lamarck's
Darwin's	*Phylogenic*	Lamarck's

I again call attention to the fact that Neo-Darwinism has hitherto presupposed and practically assumed 'fortuitous phylogenic variation' as its basis, for it is solely related with the selection of those ontogenic variations which are also phylogenic. Neo-Lamarckism, on the other hand, is solely connected with inheritable 'somatogenic' variation. Buffon's factor of the 'direct action of the environment' plays upon all four ontogenic stages, and both theoretically and as observed by experiment, produces profound ontogenic variations; the question is, under what circumstances do such ontogenic variation in each of the four stages become phylogenic? This

factor would be partly but not wholly set aside by proof that somatogenic variations are not inherited. St. Hilaire's factor of the action of environment upon early stages of development would result in purely fortuitous variations, and, as he himself clearly perceived, would require Selection to give it an adaptive direction. Nägeli's factor, on the other-hand, assumes definite but not necessarily adaptive 'phylogenic' variation—his views have been very generally misconceived on these points —and, as he pointed out, his factor would also require Selection to determine which of the definite lines of growth were adaptive.

It seems necessary to thus clearly state the relations of the time stages of variation to each of the five factors, in order to show the decisive bearings our future exact research will have upon them. For example, the proof that variation is either 'definite' or that it is 'adaptive' prior to or independently of Selection, will constitute conclusive disproof not of Darwin's theory but of Neo-Darwinism. The fate of Lamarckism, on the other hand, depends upon the demonstration that phylogenic variation is not only 'definite' and 'adaptive' but that it is anticipated by corresponding somatogenic variation.

A review of recent thought upon the variation problem shows that these life stages are becoming generally recognized. I shall pass by Lamarck's and Darwin's factors which are so thoroughly understood and speak only of the other three.

Buffon's Factor in Variation.

As regards Buffon's factor, which is the most comprehensive of all, we know that Spencer and Weismann both assumed that the direct action of the environment was primarily a factor of evolution. Weismann first regarded this solely as the protozoan source of Variation, but has recently given it a wider play in the action of environment upon the germ-cells as a cause not of definite variation but of variability. The line of research upon the dynamic action of environment in its influence upon somatogenic variation followed by Hyatt, Dall, and others, is paralleled in the more recent specula-

tion connecting the environment directly with gonagenic and gamogenic stages, initiated by Virchow,[12] Kölliker,[13] Ziegler,[14] Sutton, and others. In a similar vein are the suggestions of Geddes, while those of Gerlach and Ryder direct our attention mainly to mechanical alterations in the embryonic stages of development. Botanists such as Vines, Detmer, and Hoffmann have pointed to the influence of environment upon gonagenic variation. Experiments of a general character resulting principally in embryogenic and somatogenic variation have been recently carried on by Cunningham, Agassiz, and others, as illustrating the direct action of the environment. Followers of Buffon's factor are also more or less identified with Lamarckism. The distinction is mainly expressed in the terms 'kinetogenic' and 'statogenic' of Cope and Ryder; for under Buffon's factor the organism is passive, while under Lamarck's it is active. Among others who have supported Buffon's principle are Packard, Eimer, Cunningham, Ryder, and Dall.

This literature and so-called 'evidence' upon Buffon's factor exhibits the greatest confusion of interpretation, and demonstrates that our conceptions first, as regards heredity, second, as regards variation under a changed environment, require thorough recasting.[15] First as regards evolution in relation to heredity. The reversion phenomena as seen in human anatomy wholly set aside Weismann's conception of evolution as the selection of favorable and the elimination of unfavorable hereditary variations; in other words, of selection acting directly upon the germ-plasm. These phenomena indicate rather that the direct process is not one of elimination but of suppression from the later stages of ontogeny, and that only

[12] R. Virchow: Descendenz and Pathologie. *Virchow's Archiv*, CIII, p. 1886, pp 1–15, 205–215, 413–437. Ueber den Transformismus. *Archiv f. Anthropologie*, 1889, p. I.

[13] Kölliker: Das Karyoplasma und die Vererbung. *Zeitschr. f. wissenschaftl Zoologie*, 1886. Eröffnungsrede der ersten Versammlung der Anatomischen Gesellschaft in Leipzig. *Anat. Anzeiger*, II, 1887.

[14] Ernst Ziegler: Die neuesten Arbeiten über Vererbung und Abstammungslehre und ihre Bedeutung für die Pathologie. Tübingen.

[15] J. T. Cunningham: The Problem of Variation. *Natural Science*, vol. III, pp. 282–287. Also, Researches on the Coloration of the Skins of Flat-Fishes. *Jour. Mar. Biol. Assoc.*, May, 1893. (See also *Trans. Roy. Soc.*, 1892–3).

after an enormous interval of time does actual elimination occur. Abnormal nervous conditions such as seen in Anencephaly are accompanied by the revival of a large number of latent characters. In Galton's language, patent characters become latent in the course of evolution.

In Weismann's language, on the other hand, in explanation of dimorphism in hymenoptera and other types, there are certain sets of biophors corresponding to certain possibilities of adult development. Apply this to the celebrated case of the flat-fishes and the remarkable results recently obtained by Agassiz, Filhol, and Giard in artifically producing more or less symmetrical flat-fishes by retaining the young near the surface. Weismann's interpretation of the evolution of flat-fishes has always been that it was by the selection of asymmetrical and elimination of symmetrical 'determinants.' In the light of these experiments he must now recast this explanation by saying that the flat-fishes have kept in reserve a set of symmetrical 'determinants' since the period when our first record of the asymmetrical type appears, or about three million years!

This attack upon the speculations of one writer is a digression. What I really wish to bring out is the necessity of a far more critical analysis of the various kinds of evidence for Buffon's factor. This necessity may be illustrated by the different interpretations of color change in direct response to changed environment.

The most significant experiments upon color are those of Cunningham upon the flat-fishes. He has proved that during the early metamorphosis of young flat-fishes, when pigment is still present on both sides, the action of reflected light does not prevent the disappearance of this pigment upon the side which is turned towards the bottom, so that the color passes rapidly through a retrograde development; but prolonged exposure to the light upon the lower side causes the pigment to *reappear*, and upon its reappearance the pigment spots are in all respects similar to those normally present upon the upper side of the fish. It is very important not to confuse these results, of deep interest as they are, with those obtained where the environment is new in the historic experience of the organ-

ism. Experiments upon color, therefore, afford a marked illustration of the necessity of drawing a sharp distinction between cenogenic and palingenic variations. We have, in many cases, been mistaking repetitions of ancient types of structure for newly acquired structures. When the pale *Proteus* is taken from the Austrian caves, placed in the sunlight, and in the course of a month becomes darkly pigmented, there are two interpretation of this pigmentation; either that we have revived a latent character, or that we have created a new character. The latter interpretation can alone be taken as a proof of Buffon's factor when it is found to be followed by hereditary transmission.

Poulton,[16] as a supporter of Neo-Darwinism, takes this view, in reply to Beddard and Bateson, and as an induction from his beautiful and exact experiments upon the coloring of lepidopterous larvæ. After producing the most widely various colorings and markings by surrounding the larvæ during ontogeny with objects of different colors, he urges that the changes thus directly produced simply revert to adaptations to former conditions of life, in other words, that they are palingenic. Whether this interpretation is correct or not, Poulton proves that, no matter how stable certain hereditary characters may appear to be, repetition in ontogeny depends upon repetition in environment, and that there are wide degrees of ontogenic variations which do not become phylogenic at least in several successive generations.

From many other analogous researches we gather the following principle to which far too little attention has been paid in the study of the phenomena of variation in their bearing upon the factors of evolution: *It is that ontogenic repetition depends largely upon repetition in environment and life habit, while ontogenic variation is connected with variation in environment and life habit.* If the environment be changed to an ancient one, then ontogenic variations tend to regression or reversion (*i. e.*, palingeny) or practically to repetition of an ancient type. It

[16] E. B. Poulton: Further experiments upon the color-relation between certain lepidopterous larvæ, pupæ, cocoons, and imagines and their surroundings. *Trans. Ent. Soc.*, pt. IV, p. 293. London, 1892. (Contains a reply to Beddard and Bateson.)

is necessary to state clearly that there is practically conclusive evidence for such a principle, not only in the later stages of development, as in the respiratory metamorphoses of the Amphibia, but extending back to very much earlier stages than we have hitherto suspected. Thus a vast amount of evidence which has been brought forward as proof of Buffon's factor, *i. e.*, of the direct action of environment in producing definite and adaptive ontogenic variations is in reality in many cases no proof at all.

Having thus eliminated errors of interpretation, the great question still remains as to what happens when the environment is a wholly new one in the historical experience of the organism. Do the ontogenic variations exhibit a new direction? Is this direction adaptive, *i, e.*, towards progressive adaptation? What relations have such new conditions to the hereditary potencies of the germ-cells?

Out of all actual researches it becomes clear that experimentation can henceforth be separately directed upon the four stages of development, and that it will be possible in some degree to draw such lines of separation. New mechanical and chemical influences can be applied in each stage and withdrawn in the subsequent stages, the difficulty being to reach the extreme point where a profound influence is exerted without interfering with the reproductive function.

One effect of new environment upon the gonagenic, gamogenic, and embryogenic stages will be *saltation.* Ryder[17] has recently treated this in a most suggestive manner in discussing the origin of Japanese gold-fish. Turning to St. Hilaire's hypothesis, we find he had in mind embryogenic saltation mainly traceable to respiratory and chemical changes. Virchow extends the cause of sudden change further back to chemico-physical influences upon the germ-cells. The causes and modes of sudden development arising from whatever ontogenic stage demand the most careful investigation, chiefly in their bearing upon the relation of ontogenic to phylogenic variation.

[17] The inheritance of modifications due to disturbance of the early stages of development, especially in the Japanese domesticated races of gold-carp. *Proc. Acad. Nat. Sc. Phila.*, 1893, p. 75.

Galton has discussed the subject objectively under the head of 'Stability of Sports,' and Emery, under the head of 'Primary Variations,' has supported Galton's observation that such saltations often exhibit a strong capacity for inheritance. Bateson reaches in the conclusion of his work a modified form of St. Hilaire's factor of saltatory evolution, and believes that species have largely originated by 'discontinuity' of variation or the sudden accession of new characters from unknown causes, concluding that all inquiry into the causes of variation is premature. The materials he has brought together are of the greatest value, and he has already been able to throw in doubt many current beliefs, such as that variability is greater in domestic than in wild animals. His interpretation of these materials is, as we have seen, weakened, so far as it bears on our search for the evolution factors, by the fact that from the nature of most of his evidence he cannot discriminate between ontogenic aud phylogenic variation; moreover, he discards any attempt to discriminate between palingenic and cenogenic variations. This lack of analysis leads him into what appears to be an entirely erroneous induction, for the principle of discontinuity is opposed by strong evidence for continuous and definite phylogenic variation as observed in actual phyletic series.

Nägeli's Factor and Phylogenic Variation.

Nägeli's factor[18] introduces us to an entirely distinct territory —to the opposite extreme from saltation. It is one we can no longer set aside as transcendental because of the strong likeness it bears at first sight to the internal perfecting principle of Aristotle. It is supported in a guarded manner by Kölliker and Ziegler. It contains the large element of truth that the trend of variation and hence of evolution is predestined by the constitution of the organism; that is, granted a certain hereditary constitution and an environment favoring its development, this development will exhibit certain definite directions, which

[18] C. v. Nägeli: Mechanisch-physiologische Theorie der Abstammungslehre. München und Leipzig, 1884.

when reaching a survival value will be acted upon by selection. I have recently[19] described as the '*potential of similar variation*' an evolution principle which seems to be well supported by palæontological evidence. It is this: while the environment and the activity of the organism may supply the stimuli in some manner unknown to us, definite tendencies of variation spring from certain very remote ancestral causes; for example, in the middle Miocene the molar teeth of the horse and the rhinoceros began to exhibit similar variations; when these are traced back to the embryonic and also to the ancestral stages of tooth development of an early geological period, we discover that the six cusps of the Eocene crown, repeated to-day in the embryonic development of the jaw, were also the centers of phylogenic variation; these centers seem to have predetermined at what points certain new structures would appear after these two lines of ungulates had been separated by an immense interval of time. In other words, upper Miocene variation was conditioned by the structure of a lower Eocene ancestral type.

This is the proper place to recall a kindred conception of Variation which has been in the minds of many, and has been clearly formulated it appears by Waagen. It is of Variation so inconspicuous and so slight that it can only be recognized as such when we place side by side two individuals separated by a long series of generations.[20] Mark the contrast with the extreme of St. Hilaire's saltatory evolution; or again, the contrast with Darwin's and Weismann's conception of Variations, not, it is true, of a saltatory character, but as sufficiently important and conspicuous to become factors in the survival of the organism. This conception of 'phylogenic variation,' as we have seen, is consistent with the application of Galton's principles to human evolution, but it finds its

[19] Rise of the Mammalia in North America. *Contr. Biol. Dept. Columbia College*, vol. I, No. 2, September, 1893.

[20] This was brought out by the writer in his Oxford paper. See *Nature*, August 30, 1894, p. 435. It has recently been independently stated with great clearness by Scott in his article Variations and Mutations. *American Journal of Science*, November, 1894. Scott, following Waagen, revives the terms 'mutation' for what Nägeli has termed 'phylogenic variation.'

strongest support in palæontology, and is the unconscious motive of dissent on the part of all palæontologists, so far as I know their opinions, independently working in all parts of the world, to the fortuitous Variation and Selection theory.

Our palæontological series are unique in being phyletic series. They exhibit no evidences of fortuity in the main lines of evolution. New structures arise by infinitesimal beginnings at definite points. In their first stages they have no 'utilitarian' or 'survival' value. They increase in size in successive generations until they reach a stage of usefulness. In many cases they first rise at points which have been in maximum use, thus appearing to support the kinetogenesis theory. In extensive fossil series we also find evidence of anomalous or neutral variations, such as Bateson has brought together, but these are aside from the main lines of evolution. They present no evidence for the Neo-Darwinian principle of the accumulation of adaptive variations out of the fortuitous play around a mean of adaptive and inadaptive characters, but they present strong evidence of the Darwinian principle of the survival of the fittest. The main trend of evolution is direct and definite throughout, according to certain unknown laws and not according to fortuity. This principle of progressive adaptation may be regarded as inductively established by careful studies of the evolution of the teeth and the skeleton. Its bearing upon Lamarck's factor of the transmission of somatogenic variation was pointed out by myself in 1889; it does not positively demonstrate Lamarck's factor because it leaves open the possible working of some other factor at present unknown, and Lamarck's factor is also inadequate; but it positively sets aside Darwin's factor as *universal* in the origin of adaptations and as a consequence 'the all-sufficiency of Natural Selection.' If Lamarck's factor is disproved, in other ways, it leaves us *in vacuo* so far as a working hypothesis is concerned.

The conclusions which Hyatt, Dall, Williams, Buckman, Lang, and Würtemberger have reached among invertebrates are independently paralleled by those of Cope, Ryder, Baur, Scott,[21] the writer, and many other morphologists. The same

[21] W. B. Scott: On Some of the Factors in the Evolution of the Mammalia. *Journ. of Morphology*, vol. V, 1891, p. 378.

general philosophical interpretation of evolution is now independently announced from an entirely different field of work by Driesch. We may waive our applications of these facts to theories, but let us not turn our backs to the facts themselves!

The Outlook for Induction.

The problems I have described are the main ones. No longer misled by palingenic variation under revival of an ancient environment, let us set ourselves rigidly to the analysis and investigation of the responses of the organism to new environment, in all four stages of development. Are these responses adaptive? Is there a teleological mechanism in living matter as Pflüger[22] has expressed it? Is this mechanism in the adult reflected and accumulated in the germ?

One most hopeful outlook is in Experimental Evolution. Bacon in his *Nova Atlantis* three centuries ago projected an institute for such experiments, which when it finally materializes should be known as the Baconian Institute. The late Mr. Romanes proposed to establish such a station at Oxford, and went so far as to institute an important series of private experiments, which were unfortunately interrupted by his death. What we wish to ascertain is, whether new ontogenic variations become phylogenic, and how much time this requires.

The conditions of a crucial experiment may be stated as follows: An organism A, with an environment or habit A, is transferred to environment or habit B, and after one or more generations exhibits variations B; this organism is then retransferred to environment or habit A, and if it still exhibits, even for single generation, or transitorily, any of the variations B, the experiment is a demonstration of the inheritance of ontogenic variations. These are virtually the conditions rightly demanded by Neo-Darwinians for an absolute demonstration, either of Lamarck's or Buffon's principle of the inheritance of embryogenic or somatogenic variation but it is important to observe that such return to a former environment is very rare in a state of nature. There is no record that such

[22] Pflüger: Die teleologischen Mechanik der lebenden Natur. Bonn. 1877.

conditions have as yet been fulfilled, for hitherto organisms have been simply retained in a new environment, and the profound modifications which are exhibited may simply be the exponents of an hereditary mechanism acting under the influence of new forces. Such experiments will probably require an extended period of time, for we learn from palæontology, as well as from palingenic variation, that phylogenic inheritance is extremely slow in a state of nature.

It is desirable to establish non-infectious experimentation involving the conditions named above, mainly as a test of Lamarck's factor. Varigny has also proposed a crucial experimental series mainly upon Buffon's factor. His volume upon *Experimental Evolution* is an invaluable review, especially of French researches in experimental transformism. Much of this is in the line brought together some years ago by Semper in his *Animal Life.* Varigny draws a valid distinction between morphological variation and physiological variation, including under the latter internal chemical and constitutional differences which are not displayed in structure but must underlie all reactions. Under the head of what I have called Gonagenic Variation, the author discusses the work of Gautier[23] upon the influence of previous fertilization in plants as well as upon the chemistry of plants in connection with color variation. He adds to the observations of Yung and Born other studies upon sex determination. He describes the experimental teratogeny or embryonic variation of Dareste, Fallon, and later observers.

Throughout Varigny's volume it is nevertheless evident that none of the studies upon Ontogenic Variation hitherto have been specifically directed to the vital problem, as they must be in the future. Varigny makes a useful suggestion as to the importance of imitating natural conditions in experimental work, but he fails to emphasize the importance of the tests set forth above in order to ascertain whether the acquired modifications have actually been impressed upon the hered-

[23] Armand Gautier: Du Mécanisme de la Variation des Etres vivants. (Hommage à Monsieur Chevreul à l'Occasion de son Centennaire). F. Alcan. Paris, 1886.

itary mechanism or merely upon the various stages of ontogeny.

Conclusions.

The general conclusion we reach from a survey of the whole field is, that for Buffon's and Lamarck's factors we have no theory of Heredity, while the original Darwin factor, or Neo-Darwinism, offers an inadequate explanation of Evolution. If acquired variations are transmitted, there must be, therefore, some unknown principle in Heredity; if they are not transmitted, there must be some unknown factor in Evolution.

As regards Selection, we find more than the theoretical objections advanced by Spencer and others. Neo-Darwinism centers upon the principles of fortuitous variation, utility, and selection as universal. In complete fossil series it is demonstrated that these three principles, however important, are not universal. Certain new adaptive structures arise gradually, according to certain definite laws, and not by fortuity.

Lamarck's and Buffon's factors afford at present only a partial explanation of these definite phylogenic variations, even if the transmission of acquired variations be granted. Nägeli's factor of certain constitutional lines of variation finds considerable verification in fossil series as a principle of determinate variation, but not as a general internal perfecting tendency. St. Hilaire's factor of occasional saltatory evolution by sudden modification of the hereditary mechanism is established, but not as yet understood, although we are perhaps approaching an explanation through experimental embryology.

Our standpoint towards Variation in relation to all the Factors requires thorough reconsideration. The Darwinian law of Fortuity and the Buffon law of the direct action of Environment, have hitherto been inductions from variations which may be largely ontogenic and transitory. They both require confirmation on data of phylogenic variation. As for Lamarck's factor, the evidence seems to be conclusive that somatogenic variation is largely adaptive; but it remains to be proved that phylogenic variations as observed in human anatomy and in palæontology are invariably anticipated by corresponding

changes in the individual, in other words, that the definite current of variation is guided by the inheritance of individual reactions and not by some other principle.

Another consideration is, that individual Variation may play a far less conspicuous rôle than we have assigned to it; in other words, that many of the most important changes in successive generations are so gradual as to be entirely inconspicuous in a single generation.

Our conception of the mechanism or physical basis of Heredity is also to be made much clearer by a series of experiments directed to palingenic variation, in order to ascertain how far the revival of an ancient environment arouses latent hereditary forces. The experiments already well advanced by Cunningham, Agassiz, and Poulton indicate that *progressive inheritance is rather a process of substitution of certain characters and potentialities than the actual elimination implied by Weismann.*

My last word is, that we are entering the threshold of the Evolution problem, instead of standing within the portals. The hardest tasks lie before us, not behind us, and their solution will carry us well into the twentieth century.

Columbia College, New York.

ON THE PRESENCE OF FLUORINE AS A TEST FOR THE FOSSILIZATION OF ANIMAL BONES.

By Dr. Thomas Wilson.

(*Continued from page 317, Vol. XXIX.*)

It is interesting to examine closely this question, and, for that purpose, critical analyses have been made of a large number of bones of different geological ages. The fluorine and phosphoric acid have been determined with exactitude and the proportion of the quantity of fluorine found in the bones to that which apatite, having an equal quantity of phosphorus would contain, has been calculated. The calculation of the fluorine of apatite is easily made by multiplying the weight of the phosphoric acid by the co-efficient 0.0892 which expresses the normal proportion $\frac{2Fl}{3P_2O_5}$

The following series of analyses of bones are arranged in chronological order of the geological formations to which they belong, commencing with the more recent deposits and descending step by step to the most ancient. (The French nomenclature is employed.)

Analyses of bones of fossil animals from various Geologic Epochs or Periods.

Quaternary.	Organic matter.	Ash				Ratio.
		Oxide of iron.	Phosphoric acid.	Fluorine.	Fluorine of apatite.	
1. Rib of a Reindeer from Montreuil (Seine), orange color passing to a bluish green by calcination. *Gain* or *increase* of carbonate of lime, slightly of chlorine, none of silica	16,40	1,45	36,95	1,07	3,30	0,32
2. Horn of Reindeer from the same place, orange-yellowish, reddened by ignition. Gain or increase of carbonate of lime, slight chlorine and silica	19,60	4,35	37,35	0,78	3,33	0,23
3. Tooth of Mammoth (*Elephas primgenius*) from the gray diluvium of Grenelle (Seine). White, slightly yellowish. An abundance of carbonate of lime	......	......	30,60	1,16	2,73	0,42
4. Vertebra of an Ox from Cindre (Allier). Yellowish white becoming bluish by calcination	17,9	0,71	37,19	0,83	2,32	0,25
5. Rib of a *Glyptodon* from the Pampas of Buenos Ayres (Argentine Republic), of average density; yellowish before and after calcination. *Increase* of carbonate of lime, chlorine in normal quantity with little silica	22,60	......	27,38	1,77	2,44	0,73
6. Shell of *Glyptodon* from same locality and with same characteristics	14,90	......	28,41	1,55	2,53	0,61
7. Mylodon, *Os dermiques d'edente*—bones of the skin or shell with tooth-like edges, from the same locality; gray-yellow, becoming gray-green by calcination. Increase of carbonate of lime, traces of chlorine, no silica	13,14	0,95	36,32	1,43	3,24	0,44
8. Rhinoceros teeth from the Cave of Grimaldi, Italy. These were in a good state. The dentine (a) which separates easily from the enamel, was fragile, white, slightly yellow, with a gain of carbonate of lime	10,72	0,40	36,95	1,32	3,30	0,40
The ivory (b) was entirely white and conserved its compactness and hardness—does not appear to have been modified in its texture nor primitive composition	5,32	......	40,34	0,50	3,60	0,14
9. Lamantin (Manatee or Sea Cow). Bones from the peat beds of Scania, Sweden. Light, very porous, black-brown passing to dark-brown by calcination	33,40	5,10	35,77	0,44	3,19	0,14
10. Man, pelvic bone from *l'Abri-sous-Ro he* of Cro-Magnon (Dordogne). Light, porous, reddish in color, becoming gray-white by calcination. A gain of carbonate of line, traces of chlorine, no silica	27,50	1,80	34.48	0,52	3,08	0,17

By grouping the results of the determinations of phosphoric acid and of fluorine, the average for the ten specimens from the Quaternary Period is established.

Phosphoric acid, ...	34.14	
Fluorine, ...	1.09	Ratio, 0.36.
Fluorine calculated for apatite, . .	3.04	

Pliocene.	Organic matter.	Ash: Oxide of iron.	Ash: Phosphoric acid.	Ash: Fluorine.	Ash: Fluorine of apatite.	Ratio.
1. *Halitherium.* Bone from the deposit of Gourbesville (Manche). Dense, color blackish, becoming gray by calcination	11,82	......	30,40	2.51	2.71	0.93
2. *Elephas meridionalis*, from Durfort (Gard). Reddish-gray, becoming blue-green by calcination. Slight gain of carbonate of lime, little of chlorine, with slight of sand	16,30	......	36,84	0.88	3.29	0.27
3. *Elephas meridionalis.* Tusk from the Saint-Prest (Eure-et-Loire), from the Geologic stage of Falunien	......	......	38,40	2 11	3.42	0.62

Average of the three Pliocene samples:

Phosphoric acid,	35.21	
Fluorine,	1.83	Ratio, 0.58.
Fluorine calculed for apatite,	3.14	

Miocene.	Organic matter.	Ash: Oxide of iron.	Ash: Phosphoric acid.	Ash: Fluorine.	Ash: Fluorine of apatite.	Ratio.
1. *Dinotherium.* Tusk from the Orleans sands (*langhien* stage). Dense, dirty-gray, becoming blue-green clouded by ignition. Gain of carbonate of lime, neither chlorine nor sulphate	6.80	1.50	38.07	2.66	3.40	0.78
2. Mastodon tusk from the deposit of Sansan (Department of Gers). Langhien stage. When broken showed white with brown veins, becoming bluish by calcination. Gain of carbonate of lime but no chlorine, no silica	7,50	0.85	36.40	2.59	3.25	0.80
3. Mastodon, tusk very compact, gray chestnut color becoming gray with a light blue tint after calcination	......	0 75	39.80	2.36	3.55	0 66
4. *Rhinoceros brachypus.* Tibia from the calcaire of Simorre (*langhien* stage). Orange color, passing to reddish-brown by calcination. Gain of carbonate of lime, chlorine in normal quantity, a little silica	9.65	......	34.73	2.80	3.10	0.90
5. Gazelle horn from the tortonien deposit of Mont-Leberon (Department of Vaucluse). Yellowish-white, becoming bluish by ignition. Much carbonate of lime, traces of chlorine, no silica	6.70	1.93	15.54	0.78	1.38	0.57
6. *Hipparion.* Radius from the same deposit as No. 5. Yellowish-white which changes not by calcination. Slight gain of carbonate of lime, traces of chlorine	7.54	0.96	37.90	0.90	3.38	0 27
7. *Hipparion* from Pikermi (Greece). Yellowish-white, persisting after ignition; carbonate of lime abundant	8.54	0.90	34.26	0.93	3.06	0.31

Average of the seven Miocene specimens:

Phosphoric acid,	33.81	
Fluorine,	1.86	Ratio, 0.61.
Fluorine calculated for apatite,	3.02	

Oligocène.	Organic matter.	Ash: Oxide of iron.	Ash: Phosphoric acid.	Ash: Fluorine.	Ash: Fluorine of apatite.	Ratio.
1. *Halitherium schinzi* from the tongrien sands of d'Etrechy (Department of Seine-et-Oise). Dense, yellow-orange, becoming reddish-brown by calcination. Carbonate of lime and chlorine in normal quantities, little silica	9.30	4.60	36.65	1.86	3.27	0.57
2. *Halitherium schinzi* from the tongrien deposit of d'Etang-la-ville (Department of Seine-et-Oise). Dense, when fractured shows brilliant dark chestnut, its powder becomes gray and remains the same after calcination. Carbonate of lime in normal quantity, traces of chlorine, little silica	8.31	2.20	36.70	3.26	3.27	1.00
3. Ruminant. Bone from the deposit of Auvergne. Grayish-white, average density with a slightly blue tint by calcination. Carbonate of lime and chlorine in normal quantities, no silica	7.83	......	38.80	2.46	3.46	0.71
4. Rhinoceros. Bone from the deposit of phosphorites of Quercy. The exterior zone is hard and compact, violet and white mixed; with an interior zone, porous, red, with white crystals of carbonate of lime. The exterior zone only was analyzed. The powder was gray and took a bluish tint by calcination. Carbonate of lime abundant. Traces of chlorine, no silica	5.90	1.80	35.08	0.62	3.12	0.20

Average of the four samples from the Oligocene:

Phosphoric acid,	38.81	
Fluorine,	2.05	Ratio, 0.59.
Fluorine calculated for apatite,	3.46	

Eocene.	Organic matter.	Ash: Oxide of iron.	Ash: Phosphoric acid.	Ash: Flourine.	Ash: Fluorine of apatite.	Ratio.
1. *Paloplotherium codiciense.* Pelvic bone from the calcaire of Jumencourt (Department of Aisne). Light, easy to pulverize, brownish, becoming a gray yellowish with bluish tint by ignition. Carbonate of lime abundant, but little chlorine and little silica	13.06	0.70	31.10	2.45	2.77	0.88
2. Crocodile—Lower Eocene. Bone of the head. Dense, black-brown, becoming reddish-brown by ignition. Notable quantity of pyrites of iron, carbonate and sulphate of lime with traces of chlorine	10.30	6.50	30.03	1.40	2.68	0.52
3. *Anoplotherium commune.* Metacarpal from la Debruge (Department of Vaucluse). Dense, fracture showing mat, with a blackish brown, studded with white crystals and brilliants of carbonate of lime. Is easily powdered when it becomes gray-chestnut, and by ignition passes to a gray-white	11.72	0.66	29.09	1.98	2.59	0.76
4. *Palætherium magnum.* Cubitus from the gypsum of Villette (Paris). Porous, fracture shows a yellow color; after ignition the powder becomes greenish-white. A gain of carbonate of lime, a little sulphate with traces of chlorine	8.67	0.80	33.70	2.05	3.01	0.68
5. Turtle. Shell from the gypsum of Paris (the lower stage ligurien). Light, porous, orange color, becoming white by ignition. Gain of carbonate of lime, notable quantity of sulphate, traces of chlorine and no silica	7.80	0.90	27.26	1.64	2.43	0.67

Average of the five specimens from Eocene:

Phosphoric acid, ...	30.39	
Fluorine, ...	1.90	Ratio, 0.70.
Fluorine calculated for apatite, . .	2.71	

Cretaceous.	Organic matter.	Ash: Oxide of iron.	Ash: Phosphoric acid.	Ash: Fluorine.	Ash: Fluorine of apatite.	Ratio.
1. *Mosasaurus camperi.* A vertebra from the chalk of Maestricht, Belgium. Porous, a grayish-brown, becoming slightly green by calcination. Carbonate of lime in large quantities, traces of chlorine, no silica......	10.18	2.50	32.73	3.06	2.92	1.05
2. Large turtle from the same locality with the same characters. The colors slightly more reddish..................	8.69	4.10	36.10	3.33	3.22	1.03
3. Reptile *dinosaur* from the superior cretaceous of Ariege. White, dense, becoming green or greenish by calcination. Carbonate of lime in considerable quantity, traces of chlorine, no silica................	7.53	0.47	32.70	2.85	2.92	0 98
4. *Iguanodon*—wealdien of Bernissart, Belgium. Black, dense, fragile; giving a powder of light gray, turning slightly yellow, but becoming clear gray with light green tint by ignition. Carbonate of lime in rather large quantity, sulphate of lime in notable quantity, no pyrites, a little silica, traces of chlorine............	6.47	2.37	32 17	2.62	2.87	0.91
5. Reptile *dinosaur*. Rib from the wealdien stage of Filgate, Southern England. Porous, brownish-gray, becoming chestnut gray by ignition. Carbonate of lime in about normal quantity, traces of chlorine, no silica......................	8.80	3.30	38.65	2.76	3.45	0.80
6. Reptile *dinosaur* of the wealdien of Lewes, Southern England. Reddish-chestnut, becoming a dirty gray with a light blue tint by ignition. Carbonate of lime in normal quantity, a little silica, traces of chlorine, absence of sulphate of lime and pyrites....................	9.20	3.18	36.32	2.59	3.18	0.80

Average of the six Cretaceous specimens:

Phosphoric acid, ...	34.92	
Fluorine, ...	2.87	Ratio, 0.92.
Fluorine calculated for apatite, . .	3.11	

Jurassic.	Organic matter.	Ash: Oxide of iron.	Ash: Phosphoric acid.	Ash: Fluorine.	Ash: Flourine of apatite.	Ratio.
A. Oolithic.						
1. *Ichthyosaurus.* Vertebra from the kimmeridigian clays of Havre. Dense, black, fracture mat, with much carbonate of lime crystallized, a little sulphate of lime, iron pyrites, a little silica and clay	17.25	0.68	6.40	0.56	0.57	0.98
2. *Teleosaurus cadomensis.* Bony escutcheon from the grand oolithic deposit (bathonien) of Caen (Department of Calvados). Dense, brownish-gray, passing to grayish yellow by calcination. Carbonate of lime and sulphate of lime in notable quantities, a little clay, traces of chlorine	7.30	0.90	34.97	2.31	3.12	0.74
3. *Pholidophorus.* From the lithographic calcaire of Cerin (Department of Yonne). Imprints of fishes. A reddish-yellow, passing by ignition into a rose color, lightly tinted with yellow and green. Carbonate of lime in notable quantity, traces of chlorine, no silica	11.62	1.05	33.94	1.89	3.03	0.62
B. Lias.						
4. *Ichthyosaurus burgundiæ.* Vertebra from the superior lias of Saint Colombe, (Department of Yonne). Dirty gray, with slightly yellowish, remaining same color after ignition. Lamellar texture due to the abundance of carbonate of lime *spathique*, traces of chlorine, a little pyrites, absence of silica and sulphate of lime	6.78	2.47	12.93	1.38	1.15	1.20
5. *Ichthyosaurus.* Vertebra from the middle lias of Calvados. Dense, chestnut mixed with white, strewed with crystals of carbonate of lime; breaks and pulverizes easily; it is broken down in the fire and it becomes yellowish-orange with traces of green; much carbonate of lime, a little silica, ferruginous clay of sulphate of lime, no pyrites, chlorine in normal quantity	8.85	2.30	11.04	0.96	0.98	0.98
6. *Teleosaurus* of lias. Dense, reddish-brown, becoming yellowish-gray, with bluish portions by ignition; much carbonate of lime, a little silica and clay, absence of sulphate of lime and pyrites of iron, chlorine normal	13.38	4.65	10.57	0.86	0.94	0.91
7. *Plesiosaurus.* Vertebra of the lower lias of Vievry, near Igornay, Department of Saone-et-Loire. Orange, slightly gray, passing to a blackish-gray by ignition. Fibrous texture, semi-crystalline, by abundance of carbonate of lime, more than the average quantity of chlorine, a little silica	15.24	2.73	14.79	2.19	1.31	1.67

Average of the seven Jurassic specimens:

Phosphoric acid, ...	17.79	
Fluorine, ...	1.44	Ratio, 0.91.
Fluorine calculated for apatite, . .	1.58	

Triassic.	Organic matter.	Ash: Oxide of Iron.	Ash: Phosphoric acid.	Ash: Fluorine.	Ash: Fluorine of apatite.	Ratio.
1. *Simosaurus.* Femur from muschelkalk of Bayreuth in Bavaria. Orange-yellow, becoming greenish-yellow by ignition. Carbonate of lime in considerable quantity; chlorine normal, no silica	11.92	2.41	19.64	1.40	1.75	0.80
2. Reptile from muschelkalk of Moselle. Light brown, becoming gray after ignition. Gain of carbonate of lime, very little magnesia and chlorine, and a little ferruginous clay	16.28	1.75	24.23	2.07	2.16	0.96

Average of the two Triassic specimens:

Phosphoric acid, ... 21.93

Fluorine, ... 1.74 } Ratio, 0.89.

Fluorine calculated for apatite, . . 1.95 }

Permo-Carboniferous.	Organic matter.	Ash: Oxide of Iron.	Ash: Phosphoric acid.	Ash: Fluorine.	Ash: Fluorine of apatite.	Ratio.
1. *Pleuracanthus frossardi.* Cartilaginous fish from Thelots near Autun (Department of Seine-et-Loire). A hard and black imprint on schist. The detached fragment gives a dark chestnut powder, becoming bluish-gray by ignition. Phosphate of iron, a little carbonate of lime, a little chlorure soluble in water, abundant residue insoluble in the acid	34.55	3.18	22.57	2.26	2.01	1.17
2. *Palaeoniscus.* Ganoide fish from Muse near Autun. Brilliant scales of a brownish-gray, becoming reddish-brown by ignition. Much iron, considerable quantity of chlorine, no carbonate of lime, insoluble residue abundant	22.27	6.70	26.20	1.55	2.33	0.67
3. *Actinodon frossardi.* A reptile labyrinthodonte from Felots near Autun. The same characteristics as No. 1	29.66	2.08	28.35	3.62	2.53	1.43
4. *Haptodus baylei.* Of the same origin and same characteristics	42.52	2.37	28.23	3.15	2.52	1.25
5. *Archegosaurus.* From Lebach near Saarbruck. A black imprint, tender, chestnut powder becoming a brownish-red by ignition. Absence of carbonate of lime and of chlorure, notable quantity of sulphate of lime and a little pyrites of iron. Insoluble residue quite abundant	6.07	6.73	28.37	2.02	2.53	0.80

Average of the five Permian specimens:

Phosphoric acid, ... 26.74

Fluorine, ... 2.54 } Ratio, 1.06.

Fluorine calculated for apatite, . . 2.38 }

Devonian.

1. *Asterolepis* Bony plates from the Devonian of Livonia, Russia. Dense, brownish-black, becoming reddish-gray by ignition. Very little carbonate of lime, notable quantity of quartz with traces of chlorine.

Organic matter,	5.20	
Ash: Oxide of iron,	3.02	
Phosphoric acid,	29.50	
Fluorine,	2.59	Ratio, 0.98.
Fluorine of apatite,	2.63	

Silurian.

The debris of fish extracted from a ferruginous bone breccia of the inferior silurian of Canyon City, Colorado, U. S. A., reported in 1891 by Mons. Albert Gaudry, after his journey to the Rocky Mountains.

Organic matter,	5.67	
Ash: Oxide of iron,	7.47	
Phosphoric acid,	32.63	
Fluorine,	2.72	Ratio, 0.94.
Fluorine of apatite,	2.90	

General observations.—Bones of the same age present great differences in their composition; but one can, nevertheless, conclude from the foregoing series of analyses, in a general fashion, that the fossilization is accompanied by an important increase in the proportion of carbonate of lime, of oxide of iron and fluorine.

For the first two of these elements, the augmentation is too irregular, too usually affected by special influences of the deposit where they were buried, to enable us to indicate with certainty the true fossil state of the bone. We frequently observe, also, a high proportion of carbonate of lime and of oxide of iron in bones which have been buried for a time, either longer or shorter, but which, after all, belong to the modern period.

It is otherwise for the fluorine, and in spite of the great variations in the proportions of this mineral remarked in the bones of the same period belonging to deposits in different localities, it does appear that we may formulate a general law of age based upon the increase in the proportion of fluorine existing in them. This law is shown with greater certainty and clearness in the comparison of the average proportions in the entire number of specimens from each geologic epoch than from the proportions in the individual specimens, and in order to render this more apparent, the table following of geologic epochs shows the average results obtained from the bones of each one of these periods. The first column gives the average proportion (as above calculated) of fluorine to that of an apatite containing the same quantity of phosphoric acid. The second column gives the average ratios of the weight of phosphoric acid to the weight of fluorine.

Geologic Periods.	The ratio between the quantity of fluorine in the bone, to that of apatite.		The ratio of the weight of phosphoric acid in the bone to that of fluorine.	
Modern	0.058	0.058	193.1	193.1
Quaternary	0.36	0.360	31.3	31.30
Tertiary				
pliocene	0.58	0 620	19.2	18.15
miocene	0.61		18.3	
oligocene	0.59		18.9	
eocene	0.70		16.0	
Secondary.				
cretaceous	0.92	0.907	12.2	12.40
jurassic	0.91		12.3	
triassic	0.89		12.6	
Primary.				
permo-carboniferous	1.06	0.993	10.5	11.30
devonian	0.98		11.4	
silurian	0.94		12 0	
Apatite normal	1.00	1.000	11.21	11 21

The averages set forth in the figures of this table are not to be taken as of absolute, but only as of relative, value. The only ones which can be considered definite are those relative to apatite on the one side and to the modern bones on the other. For the fossil bones, the average not only varied with

the choice and number of the specimens analyzed, but the specimens taken for analysis were varied as much as possible and in sufficient number as to leave no doubt as to the correctness of the final result. There is a progressive increase in the quantity of fluorine as compared with the quantity of phosphoric acid, between the bones of modern times and those of quaternary times; and that the latter contain, on the average, six or seven times more than do the bones from the tertiary, secondary or primary epochs.

The tertiary bones contain, on the average, eleven times more fluorine than the modern bones, and this augmentation appears gradually from one geological period to another.

The bones belonging to the secondary epoch have a proportion of fluorine sixteen times more, and those of the primary, eighteen times more than the modern bones.

The bones of the most ancient epochs have almost exactly the same proportion of crystallized apatite; the secondary bones are not far behind, but the loss becomes sensible in the tertiary bones, and more so in the quaternary bones. The contrast is still more striking in modern or recent bones, where the fluorine is found in a minimum proportion.

Causes of the increase of Fluorine in Fossil Bones.—What can be the cause of this progressive enrichment of fossil bones in fluorine? How can one explain that this increase has for a general limit the proportion of fluorine in apatite, although this limit is sometimes exceeded? It seems proper to say "increase of proportion of fluorine," as we could not admit for an instant that the bones of ancient animals contained during their life the proportions of fluorine which we now find in them. Even if this were not opposed to known physiological law, it would still become necessary to reject the theory because of the considerable difference observed in the composition of bones coming from the same species, whether from the same or from different epochs. The question arises—what could have been the vehicle of the fluorine? We can only think of gas or liquid, i. e., of something belonging to atmosphere or water. But as we have no knowledge of any chemical condition of fluorine under which it could be carried in a

gaseous state in a humid atmosphere in the sedimentary strata, we are obliged to conclude that it penetrated into these strata under the form of an aqueous solution. It is, therefore, to infiltration of water, that has, during the lapse of time, come in contact with these fossil bones, that we must attribute this increase of fluorine, as well as other chemical changes, like the fixation of oxide of iron, the fixation and more rarely the disappearance of carbonate of lime, the solution of phosphate, etc. According to all appearance, the infiltrating water carries traces of fluorine in solution, and these traces have been fixed progressively on the phosphate of lime, by virtue of some sort of affinity which we may suspect, remarking that all crystallized phosphates of lime contain fluorine (or chlorine) in a constant quantity. But there are other proofs—the affinity of the phosphate of lime for fluoride or for chloride of calcium at a high temperature has been demonstrated by the experiments made in connection with the synthesis of apatite, which synthesis was made first by Mons. D'Aubrée (by means of lime and chloride of phosphorus), then by Forschammer (by phosphate of lime and chloride of sodium), then by H. Sainte Claire Deville and Caron (by phosphate of lime and chloride of calcium).

Experiments have been made to determine whether the same affinity was sensible in the cold and by the wet way; and if the phosphate of lime in modern bones could fix the fluoride of calcium in analogous conditions with those in which the fossil bones must have been (save and except the lapse of time and the degree of concentration of the liquids).

Experiment No. 1.—A bone of a manatee (in fragments) was placed in 200 cubic centimetres of a solution of alkaline fluoride diluted to the 50th part, containing 2 grams of carbonate of ammonia. At intervals of time, longer or shorter, fragments of this bone were taken out, carefully washed and dried and subjected to analysis for fluorine. The proportion of bone in the fluorine was originally $\frac{31}{100}$ of one per cent. After remaining fifteen days in this solution, had increased to 1.70 per cent. After remaining a month in the liquid, it contained 2.81 per cent, and after five months, 7.74 per cent. The pro-

portion, however, of phosphoric acid had, on the contrary, been reduced from 38.93 to 35.06. There had been a formation of fluoride of calcium at the expense of the original phosphate of lime and carbonate of lime, and a mixture which contained more fluorine than apatite had been formed; for the latter would have contained only 3.13 of fluorine instead of 4.74.

Experiments 2 and 3.—Two analogous experiments were made with solutions of chloride in which were placed the fragments of the bones of the manatee containing at the beginning $\frac{16}{100}$ of one per cent of chlorine in the form of an insoluble compound. After remaining for three months in a solution of one tenth of chloride of sodium, we showed $\frac{16}{100}$ of one per cent (0.16) of insoluble chlorine. After three months in solution of one-twentieth of chloride of sodium and one-twentieth of chloride of calcium, the bones contained 0.24 per cent of chlorine in an insoluble state. Therefore, there had not been any fixation of chlorine by the action of chloride of sodium alone on the phosphate of lime, but it was by the action of chloride of calcium; the proportion of chlorophosphate formed was otherwise much less than that of fluophosphate produced by a solution, even very feeble, of an alkaline-fluoride. We can conclude that the affinity of phosphate of lime is much greater for the fluoride than for the chloride.

Experiment No. 4.—In other experiments, instead of using an alkaline-fluoride easily soluble in water, there was employed fluorspar in fine powder, to which was added distilled water, with a little carbonate of ammonia, a salt which frequently forms near, on, or in the bone by reason of the decomposition of organic matter, and which can aid in the solution of a small quantity of fluoride of calcium.

The fragments of the bones of the manatee were placed in an uncovered vessel with sand, with 200 cubic centimetres of distilled water and 2 grams of carbonate of ammonia, and it was noticed that the proportion of fluorine which, at the beginning, was 0.31 per cent, became 0.35 at the end of the month and 0.43 at the end of three months. While the bones were thus immersed, the solution was frequently shaken and

distilled water added to replace loss by evaporation. There was, under these conditions, a notable increase in the bones, of fluoride of calcium, despite the slight solubility of the fluorspar employed as a re-agent. We then have the right to suppose that the continuous action during an indefinite time could produce a fluoration much more advanced than that shown in the experiment. The analyses or attempts did not succeed the same in closed vases where the bones were in the presence of the powder of fluorspar and of carbonate of ammonia of 2 grams, whether with seltzer water only, or with the seltzer water and sand. After three months of trial, one of the bones showed 0.32 and the other 0.31 of fluorine.

The experiment was also made of the action of a copper-zinc couple in the mixture; but at the end of four months this contained still 0.30 per cent of fluorine, about the same as at the begininng. From these negative results we may make certain inductions which may be of utility in explaining the phenomena.

There was realized in experiments 1 and 4 the gradual fixation of fluoride of calcium on the phosphate of lime of the bones, whether using fluoride of calcium in powder (of which a small proportion was dissolved in the water containing carbonate of ammonia), or whether in producing action upon the bones by a small quantity of alkaline fluoride in solution. The alkaline fluoride can act directly upon the phosphate of lime in giving birth to fluoride of calcium and to a soluble alkaline phosphate, from which results a diminution of the proportion of the insoluble residue of phosphoric acid; or it can produce action of the alkaline fluoride on the carbonate of lime which is found mixed with phosphate in the bone and which causes the formation of fluoride of calcium.

In cases where the fluoration takes place under the sole influence of fluoride of calcium, it ought to have for its extreme limit, the proportion which we observe in apatite—that is, about one part of fluorine to 11 parts of phosphoric acid. But if the alkaline fluoride intervenes, the fluoration can go farther and reach a proportion much higher than that of apatite. This was shown in Experiment No. 1, and it has been observed in fossil bones and in phosphates of organic origin.

Among the preceding analyses to be especially mentioned are those of three bones from the Permian of Autun (*Pleuracanthus, Actinodon* and *Haptodus*) those of two bones from the Lias of Igornay and of Saint Colombe (*Plesiosaurus* and *Ichthyosaurus*), the two bones from chalk of Maestricht (*Mosasaurus* and large turtle). The same effect was remarked by M. Phipson before the Acadamie des Sciences, Oct. 3, 1892. It is, therefore, not rare to meet with proportions of fluorine greater than that of apatite for the same quantity of phosphorus.

In some of the experiments heretofore given the proportion of fluorine, compared to that of apatite, which is taken for the unit, was increased from 1.03 to 1.67. The excess of fluoride of calcium can be attributed to the action of the alkaline fluoride in the solution, alone or mixed with fluoride of calcium, while the latter has perhaps alone produced the metamorphoses of the bones in which the proportion of fluorine does not exceed or perhaps has not even attained that of apatite.

In every point of view, in order to explain the fluoration of bone, there is admitted the existence of fluorine in solution in the waters which come in contact with these bones; at least this is the most plausible supposition, for, on the one hand, the fluorides and in particular the fluoride of calcium is sufficiently prevalent, not only in the crystalline rocks, notably in the masses of granite and granulite, but also in a certain number of sedimentary rocks, for example, coal-bearing strata in arkoses of Burgundy, in the *muschelkalk*, even in the *calcaire* of Paris, which appear to sufficiently indicate that waters charged with fluoride of calcium can circulate throughout these deposits; and on the other part, the fluoride of calcium not being completely insoluble, the infiltrated water, either more or less charged with carbonic acid, and with alkaline salts and salts of ammonia, could take it up from the rocks through which the water traversed and which are more or less impregnated with fluorine.

Many analyses of various waters reveal the existence of fluorides in solution even though in minute quantities. Nicklès found it in the waters of the Seine at Paris, of the Somme at

Ameins, of the Rhine at Strasbourg, and of the mineral waters of Plombières, Contrexville, Antogast, Chatenois, Vichy (Compte Rendus, 1857, Vol. I, page 783; Vol. II, pages 250 and 331). Also by Charles Mène in the waters of the Rhone, Saone, Loire; by Rose in the well-waters of the neighborhood of Berlin (Compte Rendus, 1860, Vol. I, page 731); in the waters of Plombières by Jutier and Lefort (9 or 10 millegrams per litre); Carlsbad by Berzelius (3 mg, 2); Kreusbrunnen by Berzelius (traces); Kissingen and Aix-la-Chapelle by Leibig (traces); d'Orezza by Poggiale, the latter ones cited in the Dictionaire de Chimie by Wurtz, Vol. II, page 1206.

Clemm and Forchhammer recognized in the deposits formed by the evaporation of sea water, phosphate of lime accompanied by carbonate and fluoride (Daubrée, Gisements de chaux phosphatée, Annales de Mines, 1868, page 81.)

The existence of fluorides has been also discovered in different substances, both animal and vegetable, as blood, milk, urine, yellow of the egg (Nicklès, Compte Rendus, 1857, Vol. II, page 331; Tamman, Zeitschrift f. physiolog. Chimie, 1888, page 322).

And finally, this substance is much more extensively diffused than has been generally believed. There is, therefore, nothing astonishing that the infiltrated waters which come in contact with animal bones should contain in small quantities the fluorides in solution, and should produce, in the course of a long period of time, a sensible modification in the composition of those bones; but which must have been affected with extreme slowness because of the very feeble proportion of fluorides in solution. Ordinarily the traces are so minute that it is extremely difficult to recognize them by analysis, and it must have taken a great number of centuries for the variation in the proportion of fluorine to become appreciable. The other changes in the nature of bones are often much more rapid and more irregular. An augmentation of several hundredths in the proportion of oxide of iron can be produced in a short interval of time. It is the same with a notable variation in the proportions of phosphate and carbonate of lime; while, as for the silica, sulphate of lime, pyrites

of iron, they are encountered only in an accidental manner. The different modifications in the chemical composition of bones, depend essentially upon the nature of the filtrating water and by consequence with that of the strata which they percolate.

It is the same as to the proportion of organic matters which diminish with time, but in a very irregular fashion according as the earth is more or less permeable. There is even to be found, sometimes, considerable organic matter in bones of great antiquity. The differences are too great between one deposit and another for us to be able in general to draw from the presence or the proportion of these elements, any induction as to the length of time the bones have remained in the earth.

The fixation of fluorine upon the phosphate of the bones is subordinate in a certain measure to the conditions of the deposits and surrounding earth. The local circumstances have probably a much less influence because of the slowness of the phenomena. In any case, the series of analyses which are here given, show clearly that the proportion of fluorine increases at a perceptible rate during the later geological periods, and that it can furnish in consequence better than the other elements a characteristic indication of the antiquity of the bone.

The following conclusions seem to be justifiable. In the different deposits of the primary and secondary geologic epochs, the relative proportions of fluorine and of phosphoric acid are, upon the average, about the same as in crystallized apatite. In the tertiary and quarternary deposits there is a progressive and marked decrease in the proportion of fluorine, but this proportion remains during these epochs much higher than in modern times. It will, perhaps, be possible to use this means to fix the veritable age of certain human bones which have been found in the neighborhood of quaternary animals, but the deposits of which may have been disturbed and the bones mixed. We cannot at present, from these experiments, establish this as a general method for the determination, accurate or absolute, of the degree of antiquity of

human bones in all deposits, for the different chemical compositions of the deposits may produce differences in the composition of the bones which will neutralize all our efforts in this direction.

The incident at Billancourt affords an excellent illustration. Mons. Riviére, of Paris, sent to Mons. Carnot at the Ecole des Mines, two fragments of animal bones and one human tibia to be submitted to analysis (Bull. Soc. Anthrop., Paris: No. 6, 15 July, 1893, Vol. 4, 4th Serie, page 309). The animal bones were white, friable and quite dense; the human tibia was brownish-yellow, light and soft enough to crush under reasonable pressure. The ignition showed the following: In the animal bones, the organic matter was from 12.93 to 12.69; with the human tibia it was 19.65, and, therefore, the decomposition of the latter was much less than that of the first. The ash of the animal bone was a greenish-white; of the human, a bluish-gray attributable probably to phosphate of iron. The determination of peroxide of iron gave in effect 0.19 to 0.21 for the animal bone, and 3.06 for the human tibia. This difference gives a presumption against the age of the two sets of bones being the same. The proportions of carbonate of lime differed slightly; for carbonic acid, the animal bones gave from 6.06 to 4.75, while it was 6.15 in the human tibia. The determination of the phosphoric acid and fluorine were as follows:

	Fossil animal. Long bones.	Fossil animal. Scapula.	Modern? Human Tibia.
Phosphoric acid	34,30	35,67	28,72
Fluorine	1,43	1,84	0,17

The phosphoric acid, then, had diminished more in the human bones than in the animal as though the latter had been more ancient. But the relationship between the phosphoric acid and the fluorine is found as follows in the three cases:

23,9	19,4	168,9

As has been established in the table on page 447, the relation between the weight of the phosphoric acid and the weight of fluorine and water was in the neighborhood of 193 in modern bones, while it became reduced to 31 in the average of quaternary bones, and 19 for their average in bones of the pliocene period. Therefore, the animal bones found in the sands of Billancourt present a relative proportion of fluorine intermediate between the average of the quaternary bones and those of the pliocene, that is to say, for the one was 23.9, for the other, 19.4.

On the contrary, for the human tibia submitted to analysis, the relation is raised to 168.9 and it is, therefore, 8 times greater than in the animal bones, and is only slightly lower than that of the modern bones. We can, therefore, conclude that the human bone belongs to an age much more recent than those of the animal, and that if it was really in the ancient gravels of the Seine in the neighborhood of the found bones of the quaternary animal, it was only by reason of a natural change of position or else the result of accident.

It is believed that this new method of control may prove to be of utility in determining the problems relative to the antiquity of man. It often happens that in the excavations made in prehistoric stations, one encounters human bones associated with animal bones, whether in alluvial deposits, caverns or rock-shelters. If the man and the animal in these deposits were contemporaneous, their bones, having been exposed to the same influence and submitted to the same transformation, ought to have approximately the same proportion of phosphoric acid and fluorine. But if the human bones are of an age much more recent than those of the animal and have been introduced either by accident or fraud, we can, perhaps, find the proof by this chemical analysis and be able to detect the error by the difference in the relative proportions between their phosphoric acid and fluorine.

(*To be Continued.*)

THE GENERA OF BRANCHIOSTOMIDAE.

BY THEODORE GILL.

The work of Mr. Arthur Willey on "Amphioxus and the Ancestry of the Vertebrates" (N. Y., 1894) is a useful compilation of what is known respecting the general anatomical characteristics of the Branchiostomids, but much remains to be yet made known regarding structural details and the range of variation, not only within the family, but also within specific limits. A first step toward the proper examination of such variations is to segregate the species into groups distinguished by positive structural peculiarities or associations of characters. For the expression of such structural peculiarities, generic diagnoses and terms are the best expedients, and they will differentiate most clearly characters of secondary importance from those of tertiary rank and the common or family characters or those of primary rank. Unfortunately, Mr. Willey has not distinguished between the various grades of characters, but has thrown all the representatives of the family into one genus without any sectional subdivision and (adapting the sequence of Dr. E. A. Andrews), has interposed "*B. cultellum*" between "*B. caribæum*" and "*B. bassanum,*" and even (unlike Dr. Andrews) added to the genus the *Asymmetron lucayanum* of Andrews. There appear to me, however, to be at least three well-marked genera. These are *Branchiostoma*, *Epigonichthys* and *Asymmetron.* Another (*Paramphioxus*) has been proposed by Prof. Haeckel (1893) for the "*Branchiostoma bassanum*" of Günther, and it is gratifying to find that my views seem to be in accord with that eminent master of discrimination and valuation of morphological characters and their expression in diagnostic form. Doubtless Prof. Haeckel has good reasons for the genus *Paramphioxus,* but he has not yet formulated its characters, although he has indicated that it has unilateral gonads, and, such being the case, it must be related to *Epigonichthys,* although apparently distinguished from it by difference in the relative development of the fins. A fifth genus is

apparently represented by the *B. pelagicum* of Günther, which may be named *Amphioxides.* The principal distinctive characters of generic importance appear to be the development of the gonads in two lateral rows or their restriction to one (right) side, the extent of the metapleural folds, the presence or want of what is generally called the ventral fin (sympodium), the extent and structure of the dorsal fin,[1] and the form of the posterior end of the body or tail.

The genera may be briefly defined as follows:

Branchiostoma.

Branchiostomids with bilateral gonads, a rayed sympodium, low dorsal fin, and sagittiform expansion of caudal fin membranes.

Contains *B. lanceolatum* and most other species.

Paramphioxus.

Branchiostomids with unilateral gonads, a rayed sympodium, low dorsal fin, and expanded caudal membranes.

Epigonichthys.

Branchiostomids with unilateral gonads, a reduced rayed sympodium, elevated dorsal fin, and expanded caudal fin-membranes.

Asymmetron.

Branchiostomids with unilateral gonads, no sympodium, low dorsal fin, and an extended attenuated tail.

Amphioxides.

Branchiostomids with bilateral (?) gonads, no rayed sympodium (?), low dorsal fin, expanded caudal membranes, and oral cirri aborted (?[2]).

[1] The so-called rays (Actinomimes) and their inclosing chambers (actinodomes) are characteristic of the Branchiostomids.

[2] "Buccal tentacles are absent," according to Günther. If such is really the case, and not the result of a failure in observation, the type is a very remarkable one, and would be an exception to a generally recognized character attributed to the family and even the order in the word "Cirrostomi."

P. S. Shortly before the proof of the present note came to hand, a brief article "On the species of Amphioxus," by J. W. Kirkaldy, became known to me; it is published in the Report of the British Association for 1894 (pp. 685, 686). Three genera are recognized, (1) *Branchiostoma* with 4 species, (2) *Heteropleuron* with 3 species, and (3) *Assymetron* with 1. *Heteropleuron* is a compound of *Paramphioxus* and *Epigonichthys*, and consequently the latter name should have been retained for it. *A. pelagicus* was overlooked by Mr. Kirkaldy as it had been previously by Messrs. Andrews and Willey.

RECENT LITERATURE.

Ord's Zoology.[1]—A patient bibliographic research undertaken by Mr. S. N. Rhoads to unearth a copy of the Second American Edition of Guthrie's Geography containing an account of North American Zoology by Mr. George Ord, was finally successful, and the one copy known to be extant was found in the possession of Dr. J. Solis Cohen of Philadelphia. Through the courtesy of the owner, Mr. Rhoads was allowed to reprint the part relating to Zoology, and in editing the work he has been zealous in reproducing as nearly as possible the style, form, paging, paragraphing, typography and inaccuracies of the original.

The desirability of a reprint of this rare book is evidenced by the numerous applications to librarians for citations from the work.

In an appendix Mr. Rhoads gives the complete titles of the different editions of Guthrie's Geography, some further historical data, and what may be termed a commentary on the species referred to by Mr. Ord. A number of names of American mammalia are settled beyond further disturbance.

A speaking likeness of the eminent naturalist faces the title page, and adds greatly to the interest of the volume.

[1] A Reprint of North American Zoology, by George Ord. Being an exact reproduction of the part originally compiled by Mr. Ord for Johnson & Warner, and first published by them in their Second American Edition of Guthrie's Geography in 1815. Edited by Mr. S. N. Rhoads. Haddonfield, N. J , 1894.

The Life of Richard Owen.[2]—In two octavo volumes of some 400 pages each, the Rev. Richard Owen has given the important incidents in the life of his grandfather, Sir Richard Owen, the leading traits in his character, and a record of his work, including his many important discoveries in anatomy and paleontology. The data upon which the biography is founded are compiled from a voluminous correspondence carefully preserved by Sir Richard Owen, comprising letters received and written, and also from his wife's diary, in which it was her custom to record fully every detail of their joint lives. As may be inferred, the "Life" is extremely interesting. The reader is on terms of intimate companionship from the first to the last page with the subject of the sketch, and is interested by turns in his domestic, social, and scientific character.

The second volume contains Huxley's essay on Owen's position in history of Anatomical Science, and also a Bibliography.

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General Notes.

GEOGRAPHY AND TRAVELS.

The Greenland Scientific Expedition of 1895.—Efforts are now making to raise a fund of $12,000 for the purpose of bringing Mr. Peary and his two assistants home from Northwest Greenland early next fall, and, in connection with this, to prosecute scientific investigations during the available summer season. It is hoped, by this means, to charter and fit out a staunch steamer built for Arctic service and commanded by experienced Arctic navigators, which shall start from St. John's, Newfoundland, on or about July 5, 1895, for Inglefield Gulf, Northwest Greenland, lat. 78° N., Mr. Peary's headquarters. The cooperation of Museums, Scientific and Educational Institutions and individuals is invited, not only because they will thus assist in the return of Mr. Peary and in the preservation of the results of his extended labors, but also because such an expedition will afford the most favorable advantages to eight or ten specialists for obtaining the rich results that are possible in a prolific field that, for a generation to come, may not again be easily and economically accessible.

These Arctic waters have been traversed eight times without an accident by the four Peary expeditions, 1891–94. No Arctic authority will dispute the feasibility of carrying on the work now proposed.

If any members of the party desire to await in the vicinity of Godhaven, Disco Island, the return of the vessel, facilities will be found here for transportation to the neighboring mainland, which, with its ice-cap, its giant glaciers, its great sheets of overflow lavas, its abundant fossil remains, and its large variety of Arctic flora and fauna will reward search with many valuable results.

The vessel should reach the coast of Greenland by July 10 or 12, and should be able to arrive at Mr. Peary's camp late in July or early in August, if it is deemed best to make only few and short stops on the northerly trip. There will then remain four or five weeks for investigations in that exceptionally advantageous region, and still leave some time for work at more southerly points, where, owing to the influence of the East Greenland current, the conditions are unfavorable in the early part of the season. After the severe season of 1893–94, an open passage through Melville Bay and a favorable summer may reasonably be expected this year.

Glacial Researches.—Every scientific member of the four Peary expeditions gives his hearty endorsement of the plans for next summer's campaign. Professor T. C. Chamberlin, head Professor of Geology in the University of Chicago, and a member of the expedition of 1894, writes of the special advantages offered for glacial researches:

"The more I work upon the results gathered last summer, the more I congratulate myself upon having made the trip. The results grow constantly upon me, both in respect of their instructiveness and their fundamental importance. Surely no field is likely to be found which throws clearer light upon the problems of glaciology than the northern portion of Greenland. The facilities for study there presented are truly remarkable. The ends and sides of the glaciers are truncated, revealing their internal nature and their methods of work to a degree that could not well be anticipated."

On Bowdoin Bay, in Inglefield Gulf, Professor Chamberlin found, last summer, nine glaciers of varying forms and habits, within a half dozen miles. It is hardly possible to find any point north of Cape York where glaciers and ice-caps, profitable for study, are not near at hand.

Zoological Work.—The study of marine life should be pursued upon a systematic plan. The results obtained by the Peary Auxiliary Expedition of 1894, clearly indicate that this work may be carried on with profit, and that large additions may be made to our knowledge of marine forms of Arctic life. Mr. C. E. Hite, of the University of Pennsylvania, a member of the Peary Auxiliary Expedition of 1892, says that the dredging results were remarkable for variety and interest. Professor Chamberlin says that, in his opinion, the glacial and biological lines in particular, may be worked harmoniously together. Not a few of our museums desire specimens of walrus, with which these waters abound. In 1893, Mr. Peary secured over twenty of these animals in a few days' hunt. White whale, seal, narwhal, reindeer, Arctic hare, blue fox, birds of various kinds, and insects, may also be procured.

Ethnological Studies.—The Anthropologist can hardly experience anything more instructive than first contact with the native or pure Eskimos, who, by isolation, have been preserved, in all respects, as the most primitive of human beings. They are to be found only in an almost inaccessible district of East Greenland and along the coast line, soon to be visited, between Cape York and Inglefield Gulf. Ethnological collections of great interest may be made at almost every point. The materials furnished by these people would equip a full ward in any Ethnological Museum; and here the primitive phase of

developmental anthropology may be studied with the greatest advantage.

Botanical and Other Work.—Complete botanical studies in this region, whose flora is developed in considerable variety by the continuous sunlight of a few short months, will be of much interest. It is desired also that artistic and excellent results of photography be secured in large variety. The photographs of glaciers already brought from this region show that nothing can be more helpful to the study of these phenomena than the graphic pictures revealing every phase of glacial activity. This region will afford to all the lines of work here mentioned nearly equal opportunities and very valuable results.

Mr. Peary, who has done great service in opening this interesting region to scientific study, will render every aid in his power to the expedition. His thorough knowledge of the natives, of methods of travel and work, and of points of interest, will greatly facilitate the present undertaking; and, conspicuous among its results, will be the fact that it will bring back, not only the fruits of its own labors, but also the product and records of the able and brilliant explorer who, for several years, has devoted all his time, energy and money to the study of Arctic life and phenomena, and to widening the bounds of geographic knowledge in the North Polar area.

The following resolution was passed by the Council of the American Geographical Society at its meeting on March 2, 1895: "*Resolved*, That the American Geographical Society heartily approves Mrs. Josephine Diebitsch Peary's project for the relief of Mr. Peary, and the prosecution of Arctic scientific research, and that it hereby contributes one thousand dollars towards the expenses of such expedition, provided that other subscriptions, sufficient to make up the sum required to send the expedition, are obtained by Mr. Diebitsch."

The business management of the expedition will be in the hands of the undersigned, Mr. Emil Diebitsch, who was a member of the expedition of 1894.

A limited number of Scientific Societies, Educational Institutions, or individuals, contributing $1,000 to the fund, will be entitled to have each a representative on the Expedition, who shall be approved by the scientific leader. The expenses of each member over and above $1,000, will be the cost of his scientific outfit, transportation from his home to St. John's, and from New York or Philadelphia to his home. The proposed work will require three months.

All communications and requests for further information should be addressed to

Emil Diebitsch,
Business Manager of the Greenland Scientific Expedition of 1895,
2014 Twelfth St., N. W., Washington, D. C.

MINERALOGY.[1]

Recent Books.

Fletcher. The Optical Indicatrix and the Transmission of Light in Crystals.[2]—This treatise is an important one for mineralogical students because of its simple form and style and its easy mathematical demonstrations. It is Fletcher's opinion that, since Fresnel's hypothesis that the medium for transmission of light—the ether—is incompressible, has been shown to be untenable, it should be abandoned by teachers. The newer theory of Neumann and MacCullagh that the ether is compressible, he supports, but wisely advises that since we may be dealing with only an approximate mechanical analogy, it is best to make use of terms which do not commit one to either of the hypotheses. The surface of elasticity he proposes to call the *optical indicatrix*. The wave surface of Fresnel he prefers to call the *ray surface*, and *ray front* is substituted for wave front. The plane passing through the ray and the normal to the plane of polarization, he designates simply as the *transverse plane*. The optic axes of biaxial crystals are called *bi-normals*, and the "secondary optic axes," or directions of common ray velocity, he calls *bi-radials*. The author shows that Fresnel did not, as supposed, arrive at the wave surface as a deduction from his theory of the incompressible elastic ether, but by a simple generalization before his theory of the ether was developed. Chapter II, of Fletcher's work, is devoted to the evolution of the optical indicatrix, and begins by remarkably simple statements of the accepted views concerning the nature of light, its transmission in isotropic media, reflection, refraction, polarization, etc., with the facts on which they are based. The ray surface and indicatrix are then developed from empirical data. It is unfortunate that the printing of the book should have been so badly done. It has been translated into German by Ambronn and König[3].

[1] Edited by Dr. Wm. H. Hobbs, University of Wisconsin, Madison, Wis.

[2] The Optical Indicatrix and the Transmission of Light in Crystals, By L. Fletcher, M. A., F. R. S. Pp. xii and 112. Henry Frowde, London, 1892. (Reprinted from the Mineralogical Magazine).

[3] Die Optische Indicatrix, Eine geometrische Darstellung der Lichtbewegung in den Krystallen, von L. Fletcher, uebersetzt von H. Ambronn u. W. König. Pp. ix and 69. Barth, Leipzig, 1893. Price, M. 3.

Hecht. Introduction to the Calculation of Crystals.[4]—The author of this valuable little book states in his preface that it gives by the method which originated with him, the general solution to the problems which arise in the calculation of crystals, and outlines a course which must, in every case, lead to the result. The necessary mathematical formulæ recommended are not difficult. A simple method is also given for making the stereographic and parallel projections. Numerous examples for practice are included in the book.

Behrens. Manual of Microchemical Analysis.[5]—This most valuable handbook is the best that has appeared treating the subject of microchemical analysis. Its appearance first in English, for it will undoubtedly be translated into German, is especially fortunate for American students. The book was written in English by Professor Behrens and edited by Professor Judd. The introductory chapter by the latter is an excellent resumé of the mechanical and chemical methods of modern petrography. Besides devising many new methods, Behrens has rigorously tested all the older ones, and furnishes data in this handbook showing the reliability and delicacy of each method. He has been careful to insure that errors arising from the differences in conditions of crystallization shall be excluded. As is well-known, the principle of Behrens' method is to get the element to be determined in the form of a sulphate, the basis for the reactions. He insists that micro-chemical reactions, to come into general use, must be suited to work with a minimum of material and secure results in a minimum of time. Part I of the work describes apparatus and reagents and the reactions which determine each element. Part II gives a systematic scheme of analysis, and has special sections for the examination of water, ores, rocks, alloys, and combinations of the rare elements. The book is full of ingenious suggestion, and should be in the library of every petrographer.

Baumhauer. Results of Methods of Etching in Crystallographical Investigation.[6]—Baumhauer, who, more than anyone

[4] Anleitung zur Krystallberechnung von Dr. Benno Hecht. Pp. 76, with 1 pl. and 5 oiled paper charts to be used in stereographic projection. Barth, Leipzig, 1893.

[5] A Manual of Microchemical Analysis, by Professor H. Behrens, with an introductory chapter by Professor John W. Judd. Pp. xxv and 246 and 84 cuts. MacMillan & Co., London and New York, 1894. Price, $1.50.

[6] Die Resultate der Aetzmethode in der krystallographischen Forschung, an einer Reihe von krystallisirten Körpen dargestellt von Dr. H. Baumhauer. Pp. 131, 21 cuts, and an atlas of 12 plates. Wilhelm Engelmann, Leipzig, 1894. Price, M. 16.

else has developed the elegant and accurate methods of etching crystals, gives us in the introduction of this work a most admirable resumé of the work that has been done and the methods that are in common use. Not only etched figures (Aetzfiguren or Aetzgrübchen), but v. Ebner's Lösungsgestalten, Hamberg's Prärosionsflächen, and Becke's Lösungsoberflächen are discussed. The studies of Meyer, Penfield, and Gill, on the forms derived by prolonged etching of spheres of quartz with hydrofluoric acid and the alkaline carbonates, and those of Hamberg on forms assumed by cylinders of Iceland spar etched with hydrochloric acid, are correlated. The author discusses in detail the application of the methods of etching to the determination of isomorphous relations. The greater part of the work is devoted to detailed descriptions of a number of important minerals on which the study of etched figures has been of special significance. Among these are the minerals: cryolite, apatite, Zinnwaldite, dolomite, nepheline, datolite, leucite, and boracite. The plates are particularly beautiful, and are suited to lecture demonstration.

Czapski. Theory of Optical Instruments.[7]—Mineralogists and petrographers who have occasion to test the working or to determine the constants of compound microscopes, will find this recent work of the scientific expert of the Zeiss Optical Works at Jena of much practical utility. The greater part of the work is devoted to a complicated mathematical exposition of Abbe's theories of optical instruments, this latter term being interpreted to include only those instruments which form images of external objects, chief among which are the eye, camera lens, microscope, and telescope. The portion, however, which will find most use among mineralogists and petrographers, is included in the last two chapters. Here the compound microscope, with its modern accessories, is described in respect to construction and use, and methods are given for the practical determination of its optical constants.

Fuess. Instrument Catalogue.[8]—R. Fuess, the well-known goniometer and microscope maker, has issued a supplement to his catalogue of 1891. The supplement treats of goniometers, universal apparatus, microscopes (with many recently devised attachments), grinding apparatus, mounting materials and collections of thin sections.

[7] Theorie der optischen Instrumente nach Abbe, von Dr. Siegfried Czapski. Trewendt, Breslau, 1893. Price, M. 9.60. (Reprinted from Vol. II of Winkelmann's Handbuch der Physik.)

[8] Ergänzungen zum Preis-Verzeichnisse 1891, über krystallographische und petrographische Instrumente, von R. Fuess, Berlin-Steglitz, 1894. Pp. 56.

The catalogue is very greatly increased in value by its references to the literature on the construction and use of each piece of apparatus which it describes.

Klockmann. Text-Book of Mineralogy.[9]—While the English language can boast the best completed reference work on mineralogy—the sixth edition of Dana's System—it is a lamentable fact that it does not possess a single modern class text of the subject. In contrast with this, the Germans have several, the best being those of Tschermak and Bauer. To these has been recently added another by Klockmann, the Professor of Mineralogy and Geology in the Royal Mining School at Clausthal. Klockmann's text is somewhat shorter than any of the others, having but 467 pages (Tschermak, 606; Bauer, 562), but by means of synoptic descriptions and abbreviations in the systematic portions, it is made to include nearly as much material. The book is a very valuable acquisition, and, to the writer of these notes, seem to possess some advantages over either Tschermak or Bauer for the use of its material in the general courses of American universities and colleges. Excellent judgment has been shown in the selection and arrangement of material, and, perhaps, because of the author's position in a mining academy, the minerals which are of economic importance are given more prominence, and more stress is laid upon the geological occurrence and the mineral association than upon the list of localities. The great aid to the memory which the dualistic formulæ furnish seems to be a sufficient reason for making use of them with elementary classes. In view of the general adoption of the index symbols, either alone or with the Naumann's symbols, it will probably be questioned whether it is wise to make exclusive use of the latter symbols in a text-book, but it is difficult to give students familiarity with both systems at the outset without drawing too much of their attention from more important matters, and the student finds it easier to deal with parameters than with indices. The section on the optical properties of minerals is probably the best in the book. In the descriptive portion, symbols, abbrevations, italics, and small type have been used to excellent advantage to aid the eye in referring to the descriptions and to indicate degrees of importance of the subject matter. In the appendix is included, first, synoptical statements concerning minerals of economic importance—ores, gems, etc.; and, second, a key

[9] Lehrbuch der Mineralogie für Studierende und zum Selbstunterricht, bearbeitet von Dr. F. Klockmann. Pp. xii and 467, with 430 cuts in the text. Enke, Stutgart, 1892. Price, M.

for the determination of the common minerals from an examination of their physical properties.

American mineralogists will look forward with interest to the text-book of mineralogy which is now in preparation for MacMillan & Co., by Mr. H. A. Miers, of the British Museum.

W. H. Hobbs.

PETROGRAPHY.[1]

Granite Inclusions in Gabbro.—Inclusions of granite in the gabbro of the Cuillin Hills, Skye, England, afford excellent illustrations of the effects produced by the fusion of acid rocks on a molten basic one. The granite in question is reported by Judd[2] to be a biotite or a hornblende-biotite variety. Near the periphery of the mass the biotite and hornblende are replaced by augite, and granophyre is developed in the interstices between the phenocrysts. The gabbro, in its passage upward, broke fragments from this granite, especially from its peripheral portions, and changed them completely. The granophyric intergrowth was fused and changed to a rhyolitic glass, marked by flow lines and filled with spherulites and lithophysae. In a few instances, some of the larger granophyre groups have escaped complete fusion, in which case, their remnants remain as nuclei of large compound spherulites. Imbedded in the glass are the large crystals of the granite. The quartzes have been cracked, and into the cracks glassy material has been pressed. The feldspars are also cracked, and in the crevices thus formed, secondary feldspars have been deposited. The original augites have disappeared, and in their places are aggregates of magnetite and other secondary products. The most interesting features of the altered inclusions are the spherulites. Simple and composite varieties are both common, and the trichitic kinds described by Cross are also met with. The centers of the spherulites are nearly always grains of quartz or of orthoclase, or groups of granophyre, as already mentioned. Pyrite and fayalite are both new products of the metamorphic action.

The Geology of Pretoria, South Africa.—A long and interesting account of the geology of the gold fields near Pretoria, in the

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Maine.
[2] Quart. Jour. Geol. Soc., xlix, p. 175.

South African Republic, has appeared under Molengraaf's[3] name. The major portion of the paper is taken up with descriptions of the geological features of the region. There are in it, however, several items of petrographic interest. The oldest formation of the region embraces granites and crystalline schists. The former rock-type includes tonalites and orthoclase-plagioclase-microcline granites. In some places the rocks show evidences of dynamic metamorphism. Among the rocks associated with the granite are sericite-schists, actinolite-schists and amphibolites. Above these is another schist formation, comprising quartzites, clay slates, corundum-schists and porphyroids, and chiastolite-schists, cut by diabase dykes. The corundum porphyroid resembles a feldspar porphry. Large crystals of biotite and large corundum individuals are in a groundmass of quartz and chlorite. The whole rock is besprinkled with quartz grains. Above the schists are bedded fragmentals, with which are associated diabases, quartz-porphyres and amygdaloids. In one of the diabases a diallagic augite and a primary hornblende were detected. In the carboniferous sediments south of Reitzburg are quartz gabbro and quartz diabases, and in the Rhenosterkop in the diamond fields at Driekop, in the Orange Free States, is a quartz-amphibole gabbro containing magnetite, biotite, primary hornblende, diallage and plagioclase. The pyroxene is striated parallell to oP, and is twinned parallel to $\infty P\bar{\infty}$.

The Gabbro of the Adirondacks.—The gabbro associated with anorthosites of the Adirondacks are described by Smyth[4] as very similar to the Baltimore gabbros. They are best developed at Morehouseville and at Wilmurt Lake in the valley of West Canada Creek. The rock is a norite, in some phases a hypersthene-gabbro, both containing a brown hornblende regarded as original. The hypersthene, especially in the foliated varieties of the gabbro, which have been rendered schistose by pressure, sends tongues out into the contiguous feldspar. This stringing out of the pyroxene is so closely connected with the development of the foliation of the rock that it is believed to be a dynamic phenomenon. An analysis of the gabbro gave :

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	H_2O		Total
46.85	18.00	6.16	8.76	8.43	10.17	2.19	.09	.30	=	100.95

A black garnetiferous hornblende gneiss, which is associated with the other gneisses in the neighborhood of the gabbro, is thought to be re-

[3] Neues Jahrb. f. Miner. B. B., ix, p. 174.

[4] Amer. Jour. Sci., xlviii, 1894, p. 54.

lated to the latter rock, from which it is believed to have been derived by pressure. Around the garnets are rims composed of radiating tongues of hypersthene or of hornblende. Green hornblende is present in the gneiss in addition to the brown variety, and all the other components of the gabbro are represented in either the fresh or the altered condition.

The Dykes of the Thousand Islands.—The granites, gneisses and other rocks of the Admiralty Group of the Thousand Islands in the St. Lawrence River are cut by numerous dikes of a dark rock. These, to the number of thirty, have been studied by Smyth.[5] They are all normal diabases and olivine diabases. In the latter variety the olivine is often surrounded by a reaction rim composed of radiating plates of tremolite. The magnetite in many of the rocks of both varieties is separated from the plagioclase by a rim of biotite. This is absent when the mineral is in contact with the other rock components, hence it is regarded as a true reaction rim between the iron oxides and the feldspar.

Analcite-Diabases from California.—A series of dykes, from San Luis, Obispo Co., California, are described by Fairbanks[6] as consisting of two distinct portions. The main one is dark and fine-grained, and the other a hard, light, rock cutting the former in dykes. Both possess the same general features in the thin section, but the lighter rock possesses them in greater perfection. It consists of lath-shaped basic plagioclase, lamellar diallage and analcite. The latter mineral occurs as irregular masses in the feldspar, in wedge-shaped pieces between the plagioclase, in the form of hexagonal or rounded grains partly enclosed within the feldspars, and as the lining of cavities in the rock. It is supposed to have been derived from nepheline, as the mass analysis of the rock shows it to be very rich in sodium:

SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O	H_2O	Cl	Total
50.55	20.48	2.66	4.02	7.30	4.24	2.27	8.37	.44	tr	= 100.33

The analcite is changed partly to an aggregate of green fibres, and partly to natrolite. In the wedge-shaped areas between the plagioclase the mineral also contains prehnite crystals, and is bordered here and there by a doubly refracting substance supposed to be a soda feldspar. These are both believed to be alteration products of the analcite.

[5] Trans. N. Y. Acad. Sci., xiii, p. 209.

[6] Bull. Dept. Geol. Univ. Cal., Vol. I, p. 273.

In some of the dykes the structure is ophitic, and in others, panidiomorphic. If the author's view as to the origin of the analcite is correct, these rocks are clearly related to teschnites.

A Quartz-Keratophyre from Wisconsin.—Weidman[7] has investigated the porphyritic rock overlying the Baraboo quartzites of Wisconsin, and has shown it to be a quartz-keratophyre. It shows all the features of a lava, and is associated with tuffs and a sericite schist. The schist is at the contact of the keratophyre with the quartzite, and is evidently a result of shearing of the eruptive. The latter is porphyritic, with plagioclase and anorthoclase phenocrysts (often fractured by movements of the lava), and a few partially dissolved quartz phenocrysts in a fine-grained holocrystalline groundmass of quartz and feldspar, which, in addition to the phenocrysts mentioned, contains imbedded in it ilmenite, biotite and zircon. Many specimens show a fluxion structure and some are spherulitic—the spherules being sometimes secondary and sometimes primary bodies. An analysis of a sample of the rock gave:

SiO_2	Al_2O_3	FeO	CaO	K_2O	Na_2O	H_2O	SO_3	Total
73.00	15.61	1.95	.79	.88	4.95	1.06	.76 =	99.00

The series of bulletins, of which the author's article forms the second number, is well printed and is apparently well edited. It is a valued addition to the list of science bulletins now being published by American colleges.

Notes.—The crystalline limestones of Warren Co., N. J., contain a large number of accessory minerals, which are described by Westgate.[8] It contains irregular masses or concretions of pyroxene, hornblende, magnetite and biotite. Quartz, tourmaline, apatite, graphite and garnet are also present in it. The quartz and pyroxene are so abundant that, in some cases, they constitute rock-bodies, composed of interlocking grains of their principal constituents, with a small admixture of some others.

The nickeliferous pyrrohotite of the Gap Mine, Lancaster, Pa., forms a peripheral zone around the eastern end of an amphibolite lens, which, according to Kemp,[9] is an altered norite or peridotite. The ore is irregularly intermingled with the hornblende of the amphibolite,

[7] Bull. Univ. Wis. Science Ser., Vol. I, p. 35.

[8] Amer. Geologist, Vol. xiv, p. 308.

[9] Trans. Amer. Inst. Min. Engin., Oct.. 1894.

filling interstices between its crystals. The author is inclined to regard the ore as having separated from the rock magma, but, whether in accordance with the Soret principle, or not, he is unwilling to say.

A variolite in a small dyke at Dunmore Head, County Down, Ireland, is described by Cole[10] as an altered glass containing spherulites composed of cryptocrystalline material with a delicately radial structure. Cracks traverse the spherulites and also the groundmass of the rocks. Into some of those in the spherulites glass has been forced. Occasionally the nuclei of spherulites are crystals of plagioclase.

In a general geological article on the Essex and Willsboro' Townships in Essex Co., N. Y., White[11] records the existence of a number of bostonite, fourchite, camptonite and other dykes cutting the country rocks of the region.

GEOLOGY AND PALEONTOLOGY.

The Lakes of Central Africa.—Concerning the origin of the Central African lakes, Dr. D. Kerr-Cross advances the theory that these lakes were in the first instance, arms of the sea, as the Red Sea is at the present time. During Cenozoic time the whole continent participated in a general movement resulting in the crushing, subsidence, faulting, and upheaval which are evident on every hand. The fauna living on during these successive changes has gradually adapted itself to the varying environment. This theory is founded on the following facts collated from the author's own observations, and those of other East African travelers:

1. East Africa is a country of table-lands.

2. Its lakes, Tanganyika, Nyasa, Rulswa, Bangweolo, Newero, and to some extent those further north—not to speak of the lesser lakes—run more or less in the lie of the continent north and south, and are separated from the sea to the east by highland, and are environed by great mountain systems remote from those of the coast range.

3. The lakes are all at high elevation.

4. Some of the lakes have evidence of great volcanic activity having taken place in late geological time. There are recently extinct craters, and hot springs and lava flows.

[10] Geol. Magazine, April, 1894, p. 220.

[11] Trans. N. Y. Acad. Sci., xiii, p. 214.

5. There is a decided parallelism between the lakes and the strike of the mountains, and they occupy vast valleys surrounded by high ground or table-land.

6. The mountains consist chiefly of crystalline and schistose rocks and gneiss.

7. The number of the lakes in the centre of the continent is great, some are salt, some brackish with sodium and magnesium salts, and some are fresh.

8. Most of them have islands.

9. Some are surrounded by markedly escarped hills, with terraces rising from them. Some of these terraces denote a former higher level.

10. In some places the lakes are extremely deep. Notably Lake Nyasa shows great variation of level.

11. The fauna shows a marked resemblance to marine forms. (Geog. Journ., Feb., 1895.)

Structure of Triarthrus.—Additional discoveries relating to Triarthrus give rise to the following observation, by Mr. C. E. Beecher, upon its general organization:

"The simplicity and primitiveness of the trilobite structure will first impress the student. The variable number of segments in the thorax and pygidium in the different genera shows the unstable metameric condition of the class. The head alone seems to have a permanent number of segments and appendages. . . . . . . With the exception of the antennules, all other paired appendages of the animal seem to agree in every point of structure, and vary only in the relative development of certain parts. The appendages of the pygidium are ontogenetically the youngest, and express the typical phyllopodiform structure. Passing anteriorly, the joints become less leaf-like, until in the anterior thoracic legs they are quite slender, and the limbs resemble those of schizopods. Corresponding to this, there is through the whole series, a gradual development of a process from the coxopodite, forming a gnathobase to the limb. On the head these serve as true manducatory organs. Posteriorly, they were like the basal endites of *Apus*, and enabled the trilobite to convey food along the entire length of the axis to the mouth."

In regard to the affinities of the Trilobita, and especially their relations to Apus, Mr. Beecher points out while a general similarity of of the cephalic organs of *Apus* and *Triarthrus* is apparent, yet there are important structural features of other parts of the body in the

latter which are quite dissimilar from *Apus* and the higher crustacea, and the exact relations of the trilobite with any one group cannot be considered as fixed. Points of likeness may be established with almost every order, showing chiefly the relationship between the trilobite and the ancestors of the modern Crustacea. (Amer. Geol., Vol. XV, 1895.)

Land Animals of the Canadian Paleozoic.—The paucity of fossil remains of land animals in the older rocks renders the finding of new material of special importance. Accordingly, the announcement by Sir William Dawson of the discovery of a number of Paleozoic air-breathing animals is of great interest. Forty-three individuals, representing a number of species, have been taken from the interior of two erect trees in the Joggins Coal Mine—the same locality in which the first known Paleozoic land snail was found in 1851.

Descriptions of these remains are embodied by Sir William Dawson in a Synopsis of Air-breathing Animals of the Paleozoic in Canada, up to 1894. The Synopsis contains references to the publications in which the various species have been described, and to their localities, discoverers, and dates of discovery and description. The species described in the Synopsis are distributed as follows:

Vertebrata 26; all Batrachia.

Arthropoda 33; viz., Insects, Scorpions, Myriapods.

Mollusca 5; Pulmonate Snails.

Four of the vertebrate species are named for the first time in this paper—two from osseous remains, and two from foot-prints.

The paper concludes with a note of advice to collectors as to where and how to obtain this valuable Paleozoic material. (Trans. Roy. Soc. Canada, Sect. IV, 1894.)

The Devonian System of Eastern Pennsylvania and New York.—In a paper containing an account of a field investigation of the Devonian system of eastern Pennsylvania and New York, Mr. Prosser takes exception to the terms used by the Pennsylvania Geological Survey and proposes certain changes to bring the correlation of the Pennsylvania section nearer to that of New York. From paleontological data Mr. Prosser has been enabled to compare the formations of this region with the typical sections of the Devonian system of Central New York.

Mr. Prosser finds the Marcellus shale clearly defined, the Hamilton (of White) the Genesee shale (of White) and Tully limestone (of

White) constitute the Hamilton stage; true Genesee shales and Tully limestones are wanting; the Chemung (of White) is found to be Lower Portage; beginning with the Starucca sandstones and New Milford red shales there is a series of deposits equivalent to the Oneonta sandstones of New York; the line of demarkation between the Chemung and Catskill lies at the base of the sandstones overlying the Montrose shales; and, finally, the Mount Pleasant Conglomerate on the Pocono Plateau represents the base of the Pocono.

The classification proposed by Prosser then would be as follows:

Lower Carboniferous	Pocono	Mount Pleasant Conglomerate.
Upper Devonian	Catskill	Mount Pleasant Red Shale. Elk Mountain sandstone and shale. Cherry Ridge Group. Honesdale sandstones.
	Chemung	Portage (including Oneonta) (of Prosser). Chemung (of Prosser).
Middle Devonian	Hamilton	Hamilton (Prosser). Marcellus shales.
Lower Devonian	Corniferous	Upper Helderberg. Cauda-galli grit.

The English Tarns.—While investigating the Tarns of Lakeland, England, with the view of determining their origin, Mr. J. E. Marr discovered that many basins supposed to be rock-bound were in reality not true rock-basins, although the streams issuing from them run over solid rock close to the surface of the lake. The facts as observed by the author are these: Some of the tarns were moraine-dammed at the exit. Should the exit of the lake thus formed immediately overlie the old river-bed, the lake would have a brief existence, for the morainic material would soon be worn away. If, however, the lowest point of the morainic barrier did not lie vertically over the old river valley, the out-let stream would cut rapidly until it reached the level of the rock, and then in the majority of cases would cut sideways along the junction of the rock and the drift until it reached its original position, when the lake would be drained. But if a ridge of rock lay between the position attained by the stream issuing from the lake and the position of the former valley-bottom, denudation would be retarded,

the lakelet would become much more permanent, and its basin would be apparently rock-bound, with its surplus water flowing over a rocky outlet.

Mr. Marr concludes since many of the Tarns he examined are instances of the third class described above, that the lakes of that region, at least, give no support to the theory that the basins in which they occur were hollowed out by ice. (Quart. Journn. Geol. Soc. Feb., 1895.)

The Loess of Northern China.—The superficial deposits of Shantung formed the subject of a paper by Messrs. Skertchly and T. W. Kingsmill read before the Geological Society of London at a recent meeting in which some interesting facts were made known concerning the Loess of that region. The Loess east of the Pamirs is extensively developed over an area of over one million square miles. It is sometimes over 2000 feet thick, and occurs up to several thousand feet above sea-level. Evidence was brought forward by the authors with the intention of establishing the absolute want of connection between the Chinese Loess and the present river-systems, its original stratified condition (as shown by variation of tint and horizontality of layers of concretions) and its subsequent rearrangement to a great extent. The absence of marine shells was discussed, and the suggestion thrown out that the shells had been destroyed by percolating water. The authors gave their reasons for supposing that the Loess is a marine formation, and stated that the sea need not have reached to a higher level than 600 feet above the present sea-level, for the Pamir region where it occurs, 7000 feet above the sea, is an area of special uplift. They maintained that there are no proofs of the glaciation of Northern and Eastern Asia, so that Chinese Loess could have no connection with an area of glaciation. The zoological, ethnological, historical and traditionary evidence alike pointed to the former depression of Asia beneath the sea, and the subsequent dessication of the land consequent upon re-elevation. (Nature, March, 1895.)

Geological News, Paleozoic.—In studying the remains of Radiolarians and Sponges in the precambrian rocks of Bretagne, M. L. Cayeux arrives at the following conclusions:

(1). There exists at the base of the precambrian of Bretagne numerous sponge spicules representing many species.

(2). All, or at least nearly all, the orders of the siliceous sponges were in existence at this early period.

(3). The precambrian Radiolarians are the oldest known rhizopods, and of the Sponges the phtanites are the first in point of time. (Revue Scientifique Feb., 1895.)

The zinc deposits in the Galena limestone of the Upper Mississippi are unique in that they occur in practically undisturbed strata that show no evidence of metamorphoric action, and are found in crevices of comparatively limited extent downward. The ores are the carbonate, sulphide and silicate. As to their origin, it is suggested by A. G. Leonard that the zinc comes from the limestones in which occur the crevices. It was deposited along with the sediments by the waters of the Silurian sea into which the metallic salts were washed from pre-existing land surfaces. After deposition in the limestome beds the zinc was concentrated in the crevices by the action of drainage water percolating through the metal-bearing beds. (Proceeds, Iowa Acad. Sci. Vol. I, Pt. IV, 1894.)

Mesozoic.—In commenting on the Sauropodous dinosaur recently found in Madagascar, Mr. Lydekker notes first, that it belongs to a hitherto imperfectly known genus, first described from the Jurassic rocks of England, under the name Bothriospondylus; secondly, the lateral cavities of the vertebræ had no connection with any honey-combing of the interior, and, finally, this fossil completes the evidence that gigantic sauropodous dinosaurs ranged over Europe, India, Madagascar and North and South America during the Jurassic and Cretacic periods. From these facts Mr. Lydekker infers that, since the whole world was inhabited by such closely allied reptiles, the great continents were intimately connected with each other, and the evolution of distinct regional faunas and the separation of large southern island-continents (now, for the most part reunited with more northern lands) took place during the early Cenozoic period. (Knowledge, March, 1895.)

The remarkable resemblance of the jaws and dentition of the Cretaceous fish Erisichthe to those of the Upper Jurassic genus Hypsocormus extends to the pectoral fins and the axial skeleton, so that Mr. A. S. Woodward concludes that Erisichthe is not a "Teleostean" in the ordinary acception of the term, and that none of its known characters warrant its separation from the family to which the Jurassic genera Hypsocormus and Pachycormus belong. (Ann. Mag. Nat. Hist. 1894.)

Cenozoic.—A revision of the Cenozoic deposits of the Texas Coastal Plain has been made necessary through the accumulation of new

stratigraphic and paleontologic evidence by the State Geologist, Prof. E. T. Dumble. Of the Eocene beds, the divisions below the Fayette are retained, but the Fayette is limited to the basal sandy portion of the beds originally bearing the name, and characterized by the opalized wood it contains. The succeeding clays are called Frio, and they mark the close of the Eocene. The Neocene divisions, beginning with the lowest, are Oakville, Lapara (the coastal representative of the Blanco), Lagarto and Reynosa. The last is a widely distributed bed of gravel cemented by lime and interbedded with clays and limy sands. The basal beds of the Plistocene are the Equus, the direct correlatives of the Equus of the Llano Estacado, which are followed in turn by the Coast Clays, and the Coast Sands. (Trans. Texas Acad. Sci., 1894).

An account of an important find of Mastodon bones (*M. americanus*) near the city of Cincinnati, Ohio, is given by Mr. Seth Hayes. At least three individuals are represented. One complete jaw of an old animal, as indicated by the excessive amount of wear of the last molars presents the unique feature of two mandibular tusks. On Prof. Orton's authority it is stated that the bed from which these remains were taken is of Postglacial origin. (Journ. Cin. Nat. Hist. Soc., Jan., 1895.)

BOTANY.[1]

Notes on Mexican Lichens. I.—Sometime since a quantity of lichen material from Mexico was placed in my hands for study. The collection was made by Mr. Jared G. Smith and Professor Lawrence Bruner on and about Mt. Orizaba, in the latter part of 1891 and in the months of January and February, 1892.

The following annotated list it given as a report of the results of the study of certain genera represented in the collection, and will be followed from time to time by other "notes" as the remainder of the material is worked over.

Ramalina.

R. linearis (L. f.; Sw.) Tuckerm. Trees, etc. Orizaba. (Bruner 50).

This agrees with specimens in hb. Tuck. under this name, but is not the *linearis* of Nylander. Spores straight or curved, $\frac{12-18}{4\frac{1}{2}-7}$ mic.

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

R. laevigata Fr. Trees. Orizaba. (Smith 52).

R. denticulata (Eschw.) Nyl. Trees. Orizaba. (Smith and Bruner 53). Spores more or less curved, $\frac{13\text{–}16}{4\text{—}5}$ mic.

R. denticulata canalicularis Nyl. Trees. Orizaba. (Bruner 54).

Differs from the species in being smaller, slenderer, and the main branches becoming divided into many attenuate, channelled branches. Apothecia much as in the species. Spores smaller.

R. calicaris fastigiata (Pers.) Fr. Trees. Orizaba. Alt. 12,000 ft. (Smith 56).

R. calicaris fraxinea (L.) Fr. Trees. Orizaba. (Smith 55).

Apparently not as common as the preceding.

R. pollinaria Ach.? var.? "Trees in forest, slope of Mt. Orizaba, alt. 9–12,000 ft." (Smith 89).

Though this lichen has the aspect of *pollinaria* it differs in being more rigid, larger, and more densely branched, and in having narrower spores. It may prove to be undescribed.

Cetraria.

C. madreporiformis (Ach.) Müll. A single specimen on earth on Mt. Orizaba. (Smith 3).

Evernia.

E. furfuracea (L.) Mann. Trees. N. W. slope of Mt. Orizaba. (Smith 5).

Very plentiful at an altitude of 11,000–12,500 ft.

Usnea.

U. florida (L.) Hoffm. Trees. Orizaba. (Smith 6).

Abundant at 12,000 ft. alt.

U. florida strigosa Ach. Trees. Orizaba. (Bruner 8).

Plentiful.

U. florida mollis (Stirt.) Wainio. On oak trees, slope of Mt. Orizaba at Jalapasco. Alt. 9–11,000 ft. Not uncommon. (Smith 80).

U. florida rubiginea Michx. Trees. Orizaba. Rare. (Smith 79).

U. hirta (L.) Hoffm. Trees. Orizaba. (Smith 7).

U. ceratina Ach. Trees. Orizaba. (Smith 9).

U. angulata Ach. Trees. Orizaba. (Smith 13).

U. longissima Ach. Trees. Orizaba. (Smith 14).

U. cavernosa Tuckerm. "Hanging from branches of oak trees, Jalapasco." Alt. 10–12,000 ft. Abundant. (Smith 15).

This species is sometimes mistaken for *U. plicata*, but may be readily distinguished by the scarcity of fibrils and by the lacunose surface, even when sterile.

Alectoria.

A. ochroleuca rigida Fr. On earth. Orizaba. Common. (Smith 1).

A. fremontii Tuckerm. Trees. Orizaba. (Smith 4). Often mixed with *Usnea cavernosa.*

Theloschistes.

Th. flavicans (Sw.) Müll. Abundant on trees. Orizaba. (Smith 41). This is certainly distinct from *Th. chrysophthalmus* and should be maintained as a species.

Parmelia.

P. perlata (L.) Ach. "Growing on rocks near warm springs," Aguascalientes; Orizaba. (Smith and Bruner 27).

The thallus is not always as smooth as is common in this species.

P. latissima Fee. Trees. Orizaba. (Smith 28).

Thallus sometimes isidiophorous.

P. perforata (Jacq.) Ach. Trees. Orizaba. Common. (Smith and Bruner 29).

P. perforata hypotropa Nyl. Trees. Orizaba. (Bruner 30).

P. cetrata Ach. Oak trees N. W. slope of Mt. Orizaba. Alt. 10–12,000 ft. (Smith 31).

P. revoluta (Floerke) Nyl. Trees. Orizaba. (Smith 33).

P. kamtschadalis americana (M. & F.) Nyl. "On oak trees N. W. slope of Mt. Orizaba." Alt. 11,000–12,500 ft. Very plentiful. (Smith 36).

P. caperata (L.) Ach. On oak trees at Jalapasco. Alt. 10,000 ft. Rocks, Aguascalientes. (Smith 34).

P. conspersa (Ehrh.) Nyl. Rocks. Orizaba; Aguascalientes. Common. (Smith 35).

Some of the specimens from the latter locality belong to the f. *isidiata* Anzi.

Phsycia.

Ph. hypoleuca (Muhl.) Tuckerm. At bases of trees among moss. Orizaba. (Smith and Bruner 62).

Ph. comosa (Eschw.) Nyl. Trees. Orizaba. Common. (Smith 38).

Ph. leucomela (L.) Michx. Trees. Orizaba. Abundant. (Smith 39).

Ph. leucomela angustifolia M. & F. With the preceding. (Smith 40).

Ph. stellaris (L.) Tuckerm. On oak trees at Jalapasco and elsewhere on Mt. Orizaba. Common. (Smith and Bruner 42).

It is often difficult to separate this from the following species.

Ph. astroidea (Fr.) Nyl. Trees. Orizaba (Smith); Cordova. (Smith and Bruner 45).

Ph. crispa (Pers.) Nyl. Trees. Orizaba; Aguascalientes. (Smith 46).

Apparently one of the commonest Physcias in this region.

Ph. major Nyl. Trees. Orizaba; Cordova. (Smith 43).

The specimens agree very well with Nylander's description and with specimens in hb. Tuckerm.

Ph. dilatata integrata Nyl. Trees. Cordova. (Smith 48).

Ph. caesia (Hoffm.) Nyl. A single specimen from Orizaba, infertile. (Smith 44).

Ph. obscura endochrysea Nyl. "On oak at Jalapasco, foot of Mt. Orizaba." Alt. 10,500 ft. A single specimen. (Smith 90).

Ph. setosa (Ach.) Nyl. A single specimen, infertile, collected on trees, Orizaba. (Smith 47).

Umbilicaria.

U. anthracina reticulata (Duf.) Schaer. Common on rocks at 14,000 15,500 ft. Mt. Orizaba. (Smith 81).

This plant is so different from typical *anthracina* that it should, more properly, be regarded as a distinct species.

U. hyperborea Hoffm. "Growing on rocks at lower snow line, 15,000 15,500 ft." Mt. Orizaba. (Smith 59).

U. hirsuta papyria Ach. "Foot of Orizaba." Alt. 15,000 ft. (Smith 60). A single specimen.

U. hirsuta grisea (Sw.) Th. Fr.? Rocks. Orizaba. Alt. 15,000 ft. (Smith 82). This plant is placed here with some doubt. If it is really *grisea* it is certainly distinct as a species from *hirsuta.*

U. vellea (L.) Nyl. With the preceding. (Smith 84).

Sticta.

S. aurata (Sm.) Ach. Trunks of trees, etc. Orizaba. (Smith and Bruner 57).

The specimens are in fine fruit, the apothecia being "ample, marginal, oblique," with a thin inflexed thalline margin.

S. tomentosa (Sw.) Ach.? Orizaba. (Smith 92). Sterile and fragmentary.

S. quercizans (Michx.) Ach. Trees, etc. Orizaba, (Smith and Bruner 58). Sterile. According to Wainio (Lich. Bres. I, 189) this species should be called *St. weigelii* (Ach.) Wain.

S. sylvatica (L.) Ach.? Rocks, etc., among moss. Orizaba. (Bruner 91).

Sterile and fragmentary.

Peltigera.

Pelt. canina (L.) Hoffm. On earth among moss; Jalapasco. (Smith 64).

Pelt. canina spongiosa Tuckerm. "On the ground in dense forest, lower slope of Mt. Orizaba." Jalapasco. Altitude about 12,000 ft. (Smith 65). Well characterized by the tufted fibrils and dense spongy nap of the under surface.

Pelt. rufescens (Neck.) Hoffm.? On ground among moss; Jalapasco. (Smith 66). Sterile and fragmentary.

Pannaria.

Pan. rubiginosa (Thunb.) Delis. Trees. Orizaba. (Smith 24).

Pan. molybdaea (Pers.) Tuckerm. Trees. Motzerongo. (Smith 25). Sterile and fragmentary.

Pan. molybdaea cronia (Tuckerm) Nyl. Trees. Cordova. (Smith 26).

The thallus agrees well with Tuckerman's specimens, but the disks of the apothecia is redder and the spores are somewhat smaller.

Collema.

C. aggregatum implicatum (Nyl.) Tuckerm. Branches of trees; Orizaba. (Smith 16).

C. aggregatum glaucophthalmum (Nyl.) Tuckerm. With the preceding. (Smith 67).

Leptogium.

L. pulchellum (Ach.) Nyl. Trees, etc. Orizaba. (Smith 23).

Spores larger than usual, and much like those of *L. chloromelum* measuring $\frac{25\text{–}36}{8\ \text{–}12}$ mic.

L. tremelloides impresso-punctata Tuckerm. hb. Orizaba. (Smith 19).

Readily recognized by the impressed pits scattered over the upper surface.

L. chloromelum (Sw.) Nyl. Rocks. Aguascalientes. (Smith 22). What is apparently the same thing was collected at Orizaba growing with moss on trees.

L. bullatum (Ach.) Mont. Trees. Orizaba. (Smith 17).

L. phyllocarpum (Pers.) Nyl. Trunks of trees. Orizaba. (Smith 20).

This species is very common and is represented also by several varieties.

L. phyllocarpum isidiosum Nyl. With the species. (Smith 86).

L. phyllocarpum macrocarpum Nyl. With the preceding. (Smith 21).

Apparently one of the commonest varieties.

L. inflexum Nyl. Orizaba. (Smith 18). This species seems well distinct from *L. burgessii.*

L. inflexum isidiosulum Nyl. With the species. (Smith 93).

THOMAS A. WILLIAMS.

The Simultaneous Origin of Similar (or identical) Varieties from Different Stock.—In the summer of 1883, there appeared in a crop of Challenger Lima Beans (a garden form of *Phaseolus lunatus* in which the pods and beans are much thicker than the type), growing near Newark, N. J., a dwarf plant showing no tendency to twine or climb, but in all other respects like the Challenger Lima with its distinguishing characteristics highly developed. Eighty per cent of the seed product of this plant produced dwarf plants, the remaining twenty per cent reverting to the regular Challenger Lima type. Of the product of the eighty per cent of dwarf plants, all, or practically all were dwarf, and thus a dwarf variety of *Phaseolus lunatus* was established.

In the summer of 1884, there appeared in a crop of large White Limas (a garden form of *Phaseolus lunatus* in which the pods and beans are larger and a little flatter than the type) growing near Kennett Square, Penna., a dwarf plant showing no tendency to climb, but in all other respects like the large White Limas. Sixty-six per cent of the seed of this plant produced dwarf plants, and in the succeeding generations practically all of the plants were dwarf, thus giving us a second dwarf variety of the species. The seed from which the Kennett Square crop was grown had been produced on the same farm for several generations, and there is no possibility of the two dwarf sorts tracing back to the same stock within ten generations at least. About the same time there appeared a dwarf form of the very distinct Small White Lima or Seewell, another garden variety of the species, the dwarf plant having all the characteristics of the parent variety except the rank growing twining vine.

Again, the White Plume and Golden Self Blanching varieties of Celery, are of a distinct class of so-called self blanching sorts in which the inner leaves assume in one case a white and in the other a yellow color as the plants approach maturity. There were no such varieties in cultivation until the White Plume appeared in New Jersey and the Golden Self Blanching appeared about the same time in France. There

are many other instances of the appearance at about the same time in different locations and from distinct strains of seed, of a variation previously unknown to the species, and generally each sport retains the general character of the strain from which it sprang, having only the new variation in common.

I have annually, for the past ten years, carefully looked over from 1000 to 2000 acres of cucumbers, and a proportionate area of other vegetables all grown for seed, my object being to note any impurities or tendencies to variation in the stock, and again and again I have found some particular variation, often an undesirable one which I had never seen before, but of which I would find many repetitions during that and the succeeding one or two seasons, after which they would often disappear and give place to some new and equally distinct type. I have often noticed that any particular style of sport common to the season was common to all varieties of the species on which it occurred. I offer no theory in explanation and make no comments, but simply put on record my observations.

WILL. W. TRACY.

Some Features of the Native Vegetation of Nebraska.—The natural vegetation of Nebraska is emphatically that of the Great Plains, and thus differs much from that of the forests to the eastward, and the mountains lying westward. To say that the eastern botanist notes the absence of many familiar plants signifies nothing, since this must always be the case in comparing the flora of one region with that of another. The flora of the plains differs in many things from that of New York and New England, but the eastern man must not unduly magnify the importance to be attached to the fact that he does not find here many of the plants he knew in his boyhood days. The plains have their own plants which will eventually be as dear to the men and women who gathered them in childhood, as are the old favorites to the New Englander transplanted to the west.

A study of the vegetation of Nebraska begun somewhat more than a decade ago, soon showed that it possessed some remarkably interesting features, which my own annual botanizing trips, and the more extended explorations by the "Botanical Seminar" have brought out in stronger light. The native plants of the State are very largely immigrants from surrounding regions. By far the greater number have come from the prairies and forests lying immediately on the east and southeast, creeping up the rivers and streams, or in case of herbaceous plants, blowing overland with a disregard for the water-courses. Thus of the

one hundred and forty-one trees and shrubs which grow naturally within our borders, all but about twenty-five have migrated from the east, in nearly all cases following the streams. Of these twenty-five, about four or five may be considered strictly endemic, the remainder having come down from the mountains. In several expeditions made by members of the "Botanical Seminar" along the Missouri River from the southeast corner of the State to the mouth of the Niobrara River, it was found that many species of trees and shrubs are confined to limited areas in Richardson and the adjoining counties, (in the extreme southeastern corner of the State) and that the number of species decreases with a good deal of regularity as we ascend the river. The same general law is seen as we ascend the three great rivers, the Republican, Platte and Niobrara, which cross the State from west to east. On the other hand, as we ascend the streams, we meet here and there a mountain tree or shrub which is wandering eastward down the slope from an elevation of a mile above sea-level, in the western counties, to less than a thousand feet along the Missouri River. Thus the Buffalo Berry, Golden Currant, Low Sumach, the Dwarf Wild Cherry, and Yellow Pine have travelled half way or two-thirds across the plains; while the Creeping Barberry, Greasewood, Black Cottonwood, Rydberg's Cottonwood, Mountain Maple, Mountain Mahogany, and Sage Brush barely enter the western counties, not extending eastward of the Wyoming line more than a few miles. A couple of species of Wild Roses, the Sand Cherry, and, perhaps, the Sand Plum, appear to belong strictly to the plains.

The grassy vegetation, and the other herbaceous plants present a similar commingling of eastern and western species. Every mile which one advances to the westward brings him in contact with plants not hitherto seen, while at the same time he leaves behind him some familiar species. I know of no other place on the continent where there is a finer illustration of the commingling of contiguous floras than is to be found on the Nebraska Plains. Not a few of the herbaceous species in the southern half of the State have come up from the plains of the southwest, some, even, coming from Texas and New Mexico. Others, again, appear to have migrated from the great northern plains of the Dakotas, while here again there are endemic species, as the Buffalo Grass, Redfield's Grass, False Buffalo Grass, and many of the more showy higher plants.—Charles E. Bessey.

The Division of Agrostology.—Among the things of botanical interest done by Congress, the establishment of the Divison of Agros-

tology in the Department of Agriculture may well be ranked as of most importance. The purpose of this division is set forth as follows in the bill making the appropriation.

"*Investigations and Experiments with Grasses and Forage Plants, Division of Agrostology:* Field and laboratory investigations relating to the natural history, geographical distribution, and uses of the various grasses and forage plants, and their adaptability to special soils and climates; establishment and maintenance of experimental grass stations; employment of local and special agents and assistants; collection of seeds, roots, and specimens for experimental cultivation and distribution; materials, tools, apparatus, supplies, and labor required in conducting experiments; freight and express charges and traveling expenses; the preparation of drawings and illustrations for special reports, and the preparation of illustrated circulars of information, bulletins, and monographic works on the forage plants and grasses of North America, fifteen thousand dollars."

The liberal spirit of Secretary Morton toward scientific investigation is well shown in the wording of the section quoted, and it is a pleasure as genuine as it is rare, to be able to fully and heartily commend an action initiated wholly by a Government official. The wisdom of selecting a man who is more than, and above the mere politician for the Department of Agriculture, was never better illustrated.

CHARLES E. BESSEY.

Gray's Field, Forest, and Garden Botany.[1]—Twenty-seven years ago Dr. Gray brought out the first edition of a book under this name, which has been very widely used in the public schools of the United States, even beyond the territory for which it was intended. The old book had long outlived its usefulness, and a new edition should have been made long ago, but the death of its author delayed the revision until the present time, when from the hand of Professor Bailey we have the rewritten work.

The familiar appearance of the old book is preserved, as well as the general mode of treatment, the sequence of families, etc. In the words of Professor Bailey "it is still Asa Gray's botany, and the reviser has attempted nothing more than to bring it down to date." That this work has been conscientiously done is shown on every page,

[1] Field, Forest and Garden Botany; a simple introduction to the common plants of the United States east of the 100th Meridian, both wild and cultivated. By Asa Gray, late Fisher Professor of Natural History in Harvard University. Revised and extended by L. H. Bailey. American Book Company, New York.

and no man need ask for a more faithful adherence to the spirit of the older book than we find here. Yet this did not prevent the introduction of some modern ideas. We all know how candid a mind Dr. Gray always possessed, and how open it was to the reception of new ideas. Accordingly we find that the relation of the Angiosperms to the Gymnosperms is properly given in the new book, and that the latter are no longer "sandwiched" between the Dicotyledons and Monocotyledons.

Among other improvements to be noted in this edition are, the useful table of contents and the four pages entitled "nomenclature," the latter including valuable biographical data. The citation of the authority for each plant name will be useful in accustoming young students to the practice of botanists, but it is to be regretted that the old method had to be followed. This and a few cases in which an obsolescent nomenclature was followed, show the folly of the publishers in insisting upon too close an adherance to Dr. Gray's views of ten or more years ago. In life Dr. Gray frequently changed his views, as became a candid man of science, and it is an injustice to his memory for the "President and Fellows of Harvard College" to require that his books shall remain essentially unchanged. They would not dare to do so with a work on Chemistry or Physics, why should they for one on botany? When they authorize another edition of Dr. Gray's works they would do well to follow the example of our German friends, who are bringing out a new edition of Rabenhorst's "Kryptogamen Flora."

Professor Bailey has taken much care in the selection of the additions which he has made, and rightly he has given preference to those which are cultivated rather than the wild species. It appears from the reviser's estimates that this edition contains 553 species more than the former one, which represents considerably more than so many actual additions, since some species have been omitted. The new book will be very useful.

CHARLES E. BESSEY.

ZOOLOGY.

Web-Spinning Spiders.—The origin and evolution of web-spinning in Spiders is given by Mr. R. L. Pocock in a recent number of Nature. His theory may be briefly outlined as follows:

Granting the inheritance of silk-glands from an ancestor, the first step in the formation of web-spinning was the formation of the cocoon for the protection of the eggs. This is characteristic of all spiders. The next step would be to extend this protection about herself and the retreat in which the mother had sought refuge while watching over the incipient brood. An aperture would probably be left for ingress and egress, and so arises a rudimentary form of the tubular nest or web which may or may not become a permanent abode for the mother after the dispersal of the young. That this is the second step in the evolution of web-spinning seems supported by the fact that, with the exception of the cocoon, it is the most constant feature in the spinning industry of spiders. At this point there are two developments. Along one is a gradual ascent in complexity until a culmination is reached in the trap-door nest of the wolf-spiders (Lycosidæ) and the bird-spiders (Aviculariidæ); while the other leads to the webs which function as snares, of which the web of the Epeira probably represents the highest type.

From a tunnel-weaver like the Drassidæ which spins a temporary retreat for its breeding season, there are gradations to the web spun by the common house spider, Tegenaria, as an adjunct to its tubular retreat, and thence to the highty specialized orb-weaving of an Epeir, by way of the Nephilengys, a tropical genus, whose net shows a scanty mesh-work of lines arranged radially and concentrically with respect to the mouth of the funnel.

It would seem, according to the author, that the primary influence in guiding the evolution of the architecture of the tunnel-making species has been the necessity for the preservation of life and the avoidance of enemies; while the web has resulted from a struggle for food. (Nature, March, 1895.)

Fishes of the Northwest.—During the summer of 1892, Mr. C. H. Eigenmann obtained a series of collections of the fishes of western Canada and the northwestern United States. The collections were made at 25 different places and include material for a comparison of

the fish-faunas of the streams flowing into Hudson Bay and into the Gulf of Mexico on the Atlantic slope, and into Puget Sound and into the Columbia River on the Pacific slope.

Mr. Eigenmann has worked out the relations that these different river faunæ bear to each other by an elaborate system of comparison, and finds that 6 of the 65 species are found on both the east and west slope of the continent. Of 42 species found in the Winnipeg system 8 are found in the Saskatchewan, and not in the Red River of the North ; 16 found in the Red River of the North were not found in the Saskatchewan ; 13 of 17 species taken in the Missouri are found in the Saskatchewan. The species of the Saskatchewan, with the exception of the new ones, are all found in the Mississippi basin. 11 Families of the Mississippi basin have not yet been found in the Saskatchewan basin. Only one variety was found in the Fraser that was not found also in the Columbia.

Sixty-five species were obtained, of which 20 per cent. were new to science. They belong to 14 families and 37 genera.

The notable additions to the knowledge of the North American fish-fauna made by these explorations is shown in the following summary of the results of the author's work.

1. A species of Pantosteus (*P. columbianus*=*P. jordanii* of the Missouri) discovered on the Pacific slope.

2. *Noturus flavus* found at the base of the Rockies at Craig, Mont.

3. Four new species of Notropis added to the East Canadian fauna.

4. Two new species of Agosia added to the Pacific fauna.

5. A new species of white-fish (*Coregonus coulterii*) discovered in the Rocky Mountain streams of a restricted region in British Columbia.

6. The family of Percopsidæ found to have a representative on the Pacific slope in the new genus Columbia.

7. Several species of Etheostoma found in Canada, among them two new species.

8. One new Cottus (*C. onychus*) added to the fauna of the Saskatchewan.

9. A new Cottus (*C. philonips*) discovered at Field, B. C.

10. A species of Lota reported from both the Columbia and the Fraser.

11. It was discovered that the fins of the fishes of the Pacific slope vary from the fins of the fishes of the Atlantic slope in definite directions.

12. The extent of variation between the species of any given family of fishes on the Pacific coast was found to be greater than that between the species of the same family on the Atlantic slope.

13. Richardsonius was proved to be a subgenus of Leuciscus. Its species were found to vary directly with the locality. (Art. 11, Bull. U. S. Fish Commission for 1894.)

Queer Misfortunes of Birds.—I have noticed in a N. Y. paper, an account of a strange misfortune that happened to an English sparrow at the building of the Edison laboratory, Orange, N. J. The bird became entangled in a twine used in the construction of its nest, and met its death by hanging. This has reminded me of a similar incident that occurred to a bird last summer, near this place, Bowling Green, Ky. It was a common, or crow blackbird, and was seen hanging by the neck, from the limb of a tall tree overhanging the road. Whether in flying with a long grass or string it became entangled with it, or in what way it got caught in the noose and met its death is a matter of conjecture. A queer incident of a woodpecker has come under my notice. The bird, a hairy woodpecker, was seen on a tree trunk and though a stone was thrown towards it to see it fly, it remained in the same position. On going nearer it was found that the bill had been driven into the tree with such force that the bird could not extricate it, and had hung there, meeting a miserable death.

I have heard from a friend of an interesting life history of a mocking bird. It was quite a young bird when purchased from a negro bird-catcher, and it was soon discovered to have sore feet. These were swollen twice the natural size, and though efforts were made to relieve this, it was only after it had lost several of its toes,—two front toes on one foot and one on the other,—that the feet were finally healed. After this it moulted, losing about all its feathers at one time. Its eyes then became inflamed, and the eye-ball like a drop of water, finally closed and the bird became totally blind. In getting its food it would stand at one side of the cage and follow the wires till it reached the food, it would then follow the side of the cage till it reached the water. It soon learned, however, to guage distances and would fly to the perch without fail. It was a pitiable object, but strange to say, this poor maimed bird, lame and blind, developed into one of the finest of singers!

A caged mocking bird here, in moulting, has the new wing-feathers, the primaries at least, reversed; the upper surface turned in or partially so. The owner of the bird has been advised to pull out these feathers, that they would then grow in straight. This would seen rather a severe measure. It would be interesting to know whether this is an accident only to caged birds, or if it ever occurs to birds in a state of Nature.—Sadie F. Price.

The Cotton-Tail Rabbit.—The name *Lepus sylvaticus* proposed by Dr. Bachman in 1837, for the common gray rabbit of the United States, has hitherto been restricted to the eastern region from northern Florida to Canada. A recent investigation of the subject by Mr. Outram Bangs reveals that this region is occupied by two distinct subspecies, for the northern one of which he proposes the name *Lepus sylvaticus transitionalis,* thus restricting the true *L. sylvaticus* to the Carolinian life area. In the same paper the author in referring to the geographical distribution of the northern hare (*Lepus americanus* Erxl.), in the east, points out that the common cotton-tail (*L. sylvaticus*) is continually pushing its way farther to the north and replacing the northern hare. The latter is rare in Massachusetts, has almost wholly disappeared from many parts of New Hampshire, but is still abundant in Maine, New Brunswick and Nova Scotia. Mr. Bangs accounts for the spread of the cotton-tail to the north as a consequence of the destruction of the great coniferous forests, which are replaced by a scrubby second growth of shrubs. The hare goes with the coniferous forests and the cotton-tail comes in with the second growth. (Proceeds. Boston Soc. Nat. Hist. Vol. XXVI, 1895.)

Zoological News, Mollusca.—Mrs. M. B. Williamson reports the successful planting of Eastern oysters in the bays of Los Angeles Co., California. The oysters of Alamitos Bay are as large as those of the same age raised in the East. No star-fish or carnivorous shell fish have been detected in the oyster beds. It is possible that in stocking the beds with eastern oysters may result in planting the fry of other eastern molluscs as well, since *Mya arenaria* L. and *Urosalpinx cinerea* are now propagating in San Francisco Bay as a result of the introduction of Eastern oysters in those waters. (Ann. Pub. Hist. Soc. Southern Cal., 1894.)

Crustacea.—Four new genera of crabs, represented by a number of species, are reported by Mr. J. E. Benedict from the collections made from dredgings in the North Pacific Ocean and Bering Sea, by the Streamer Albatross. Several new species of Lithodes are included in the same collections. A number of young Lithodes, referred by the author to *L. camtschaticus* agree with Brandt's description of *L. spinosissimus,* which, according to the author, was undoubtedly founded upon a young specimen. (Proceeds. U. S. Natl. Mus., 1894.)

Agnatha.—Mr. Howard Ayres does not agree with the commonly accepted theory that *Bdellostoma dombeyi* Lac. is a parastic, degenerate

vertebrate. He asserts that its sense organs represent primitive conditions, showing no anatomical characters that justify a conclusion that they are degraded from a more perfect ancestral condition. A series of experiments has demonstrated also that this vertebrate does not depend upon its internal ears for the equilibration of its body. (Biol. Lectures at Woods Holl, 1894.)

Pisces.—In the revision of the subfamily Sebastinæ of the Pacific coast of America, Messrs. Eigenmann and Beeson have adopted a classification based upon the relation of the parietals to the supraoccipital as a primary character, and the constant presence or absence of certain cranial spines. Under the system 11 genera are defined, to which are referred 52 species. A valuable addition to the paper is a historical list of the species and their present equivalents. (Proceeds. U. S. Natl. Mus. Vol. XVII, 1894.)

Reptilia.—Dr. G. Baur places Anniella in a separate family, the Anniellidæ, close to Anguidæ, and has its closest relative in Anguis itself. In fact, the Anniellidæ are in the same relations to the Anguidæ, as are the Acontiidæ to the Scincidæ. (Proceeds. U. S. Natl. Mus. Vol. XVII, 1894.)

From a study of the herpetological fauna of the islands of Palawan and Balabac Dr. Boulenger concludes that these islands should be regarded as belonging to the same subregion as Borneo. This conclusion was reached also by Mr. A. Everett from a study of the mammals and birds of that district. (Ann. Mag. Nat. Hist. Ang., 1894.)

Aves.—Mr. Robert Ridgway reports 6 more new birds in the Abbott collection from Aldabra, Assumption and Gloriosa Islands. This makes in all 14 new forms from these islands. (Proceeds. U. S. Natl. Mus., Vol. XVII.)

Mammalia.—An Clivedale terrier bitch belonging to a coachman in my brother's employ gave birth to seven puppies, sired by a thorough bred Irish terrier; two of the puppies were born with the tails, just half as long as those of the other five. As for generations the ancestors have had their tails artifically modified, it seems as though this was a genuine case of natural following of artificial type. As the two puppies happen to be male and female it would be interesting to see if the type could be continued.—Allerton S. Cushman.

XXIII.

Fig. 1.

Fig. 2.

Cabbage Root Maggot:

1, Injured Cabbage Roots, ½ natural size; 2, female fly, Magnified.
After Slingerland.

ENTOMOLOGY.[1]

The Cabbage Root Maggot.—In Bulletin 78 from the Cornell University Experiment Station Mr. M. U. Slingerland has brought together the most elaborate account yet published of *Phorbia brassicæ* Bonché. This insect has long been known as one of the most destructive garden pests. It was introduced into "this country from Europe early in the present century, perhaps first appearing in Massachusetts, from whence it gradually spread north, west, and south into the neighboring States. In about 25 years it had reached Maine on the north, Maryland on the south, and Michigan on the west. In 20 years more it had entered Colorado, reached the Pacific Ocean, and passed through South Carolina into Alabama. In a little more than half a century it had thus spread over the greater portion of the United States and Canada. Doubtless it is now present in injurious numbers in every State where its food-plants are grown to any extent.

"Whenever the pest obtains a foot-hold, it usually appears in alarming numbers year after year if its food-plants continue to be grown in the neighborhood. In England it has been very destructive almost every year since 1880. In the United States, the gardeners in this State (especially in the neighborhood of New York City, over the line in New Jersey and throughout Long Island) and in Michigan have suffered severely from the pest almost every year, as the records show, for the past 25 years. Many market gardeners on Long Island have abandoned the growing of early cabbages, cauliflowers, and radishes on account of this formidable pest. In 1887, Peter Henderson said: 'tens of thousands of acres the past season have been, of both cauliflower and cabbage, utterly ruined by maggots.' In Canada the pest has been especially injurious in 1885, 1887, 1890, 1892, and 1893; in 1892 it was considered the most destructive insect of the year."

Concerning the food-plants of the insect, Mr. Slingerland says "that it has been recorded in Europe on the cabbage (including the cauliflower, borecoles, etc.), the radish (*Raphanus sativus* and *radiola*), the turnip (*Brassica rapa*), the ruta baga and swedes (*Brassica campestris*), and on stocks (*Mathiola*); the reported feeding on clover roots and manure needs further confirmation. In this country the Cabbage Root Maggot feeds upon most of the above plants and on at least two common Mustard-like weeds, the Common Winter Cress (*Barbarea*

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

vulgaris), and the Hedge Mustard (*Sisymbrium officinale*); the maggots infesting onions, beans, and raspberry canes are different insects, distinct from each other and from the Cabbage Root Maggot."

The presence of the pest, where it occurs in considerable numbers, is indicated by a checking of the growth of the plant, a tendency to wilt badly under a hot sun, and a sickly bluish cast to the foliage. The way in which the roots are injured is shown in the upper figure of the accompanying plate.

Mr. Slingerland discusses the life history of this and allied species, and treats of the methods of preventing its injuries at considerable length, concluding with an elaborate bibliography and synonymy. The bulletin is illustrated by eighteen excellent figures two of which we are permitted to reproduce herewith.

Ohio Dragonflies.—Prof. D. S. Kellicott publishes a valuable Catalogue of the Odonata of Ohio[2], in which 68 species are recorded for the Central and Northern parts of the State. He thinks the number of species found compares favorably with other Mississippi Valley regions of similar latitude. While lakes, ponds and morasses which are favorable homes for the nymphs of the Odonata are not numerous, many and copious streams traverse the State, and the great Ohio, the Beautiful River, on the south, and Lake Erie on the north, with its numerous estuaries and sheltered areas of reed-grown waters, compensate for the unfavorable conditions of the State at large. Whether or not the number of species is decreasing as a consequence of the profound changes due to more complete occupation of the country by civilized man, it is impossible to know. In all probability, the draining of swamps and ponds, the resulting disappearance, in Summer, of former perennial streams, and the contamination of others, will, sooner or later, produce a material reduction.

"The common names of the adults are often as striking as the forms themselves. In the central and southern sections they are almost universally known as 'snake-feeders;' in the north and northwest, as 'spindles;' in the northeast they are often 'devil's darning-needles.' Still, any one of these, and others, may be heard in any section. Among the less common designations may be mentioned the following: 'horse stingers,' 'mosquito hawks,' and 'dragonflies.' The last, used more or less everywhere, is, by far, the most desirable. It expresses so aptly and happily the characteristics of these veritable dragons of the air. No insects possess a more pronounced individuality

[2] Journal Cincinnati Soc. Nat. Hist., Jan., 1895.

than the Dragonflies ; hence, none appeal more strongly to the imagination. Their graceful forms, brilliant colors, and arrow-like flight at once arrest attention and hold the interest ; it is, therefore, not suprising that they have received so many and such poetic names. It has been said that "some of these names testify to the wide-spread, but quite unfounded, belief in the harmfulness of these creatures to man." The writer recalls at least one grown person who truly believed they were harmful. This was a school teacher, who impressed upon him, and others of her charge, that the devil's darning-needles about the 'old swimmin' hole' were dangerous, and that they were quite determined to sew up the ears of truants who sought the limpid waters and grass-covered banks of the millrace, rather than the hard and strict ways of the prosy school-room. This is the one 'fact' of Natural History he remembers to have been taught him in the 'district' school."

A Unique Journal.—The Entomological Society of the University of California has recently begun the publication of *The Entomologists Daily Post Card*, especially devoted to the insects of California and adjacent states. It contains synopses, bibliographical references and many useful notes. The subscription price is $2.00 a year, which may be sent to C. W. Woodworth, Berkeley, California.

Loss by Fire.—We regret to learn from Prof. C. H. Tyler Townsend, now stationed at Brownsville, Texas, that he recently lost by the burning of a warehouse at Las Cruces, New Mexico, his valuable entomological library which was especiallly rich in Dipterology. Mr. Townsend would be glad to receive separates of papers from entomologists, who we are sure will willingly help to replace his library.

Male Reproductive Organs of Beetles.—Dr. K. Escherich describes[3] the genital system in the males of Carabus, Blaps, and Hydrophilus. The Carabidæ illustrate the simplest state ; a simple blind tube on each side produces spermatozoa, stores the elements and secretes mucus ; each tube opens into a somewhat stronger duct, and the two ducts unite in a common ejaculatory canal. The terminal portion in this case is lined with chitin, and is, therefore, ectodermic, not the result of the confluence of the mesodermic vasa deferentia. The region corresponding to testes, vasa deferentia, and seminal vesicle are

[3] Zeitschr. f. wiss. Zool. LVII, 620–41.

mesodermic and Escherich calls them "primary organs." Starting from such a simple case as Carabus the author shows how the endless variety of complications may be reduced to some order, as illustrations of progressive specialization.—*Journal Royal Microscopical Society.*

Lamp Chimneys for Breeding Cages.—Now that the insect season is opening it will be opportune to give some attention to the methods of rearing larvæ.

The common lamp chimney makes an excellent cage for this purpose and one which commends itself by its cheapness as well as by its convenience.

If the larva is to be reared on a small potted plant, the lamp chimney is placed over it and is pressed down into the earth in the pot.

The top may be closed by tying over it a piece of muslin. A watch glass just large enough to lie within the top makes a very neat method. Lantern globes, which may be used in the same way may be closed by inverting tumblers over them.

Potted plants are not always available when the insects must be fed on leaves or stems. These may be kept fresh by putting the stems in water. A cork just fitting the bottom of the chimney is bored so as to hold a homeopathic vial for the water produces a suitable adaptation of this form of cage.—*Entomologists Daily Post Card.*

The Name of the Southern or Splenic Cattle-Fever Parasite.—The generic name given by Drs. Smith and Kilborne, having been previously used in Zoology, must be dropped. I propose the name *Piroplasma* to replace it.

PIROPLASMA BIGEMINUM (S. & K.)

Syn. *Pyrosoma bigeminum* Smith and Kilborne, Repts. Bn. An. Ind. '91–'92 (1893), p. 212, plts. IV–IX.—WM. HAMPTON PATTON, Hartford, Conn.

EMBRYOLOGY.[1]

Ascaris Eggs and Temperature.—Dr. Luigi Sala[2] has applied the experimental method to the study of that classical object, the egg of *Ascaris megalocephala.* He exposed the eggs to a low temperature from 0° to 8° C. for an hour or more and then allowed them to develop under normal conditions of temperatnre, 25 to 30° C.

In such eggs most noteworthy changes are found in the processes of maturation and fertilization. The changes that cold brings forth concern the penetration of the sperm, the structure of the protoplasm of the egg, the formation of the egg membrane, the arrangement of the chromatic substance and of the achromatic substance, the formation of the polar bodies, the formation of the pronuclei and of the first cleavage nucleus.

These results of cold are illustrated by eighty-nine carefully executed figures and cannot readily be described in words, except in most general terms.

The effect upon the egg that may be mentioned under the first category, the penetration of the sperm, are in some cases the prevention of any entrance, but in most cases the entrance of several or even as many as 12 sperms.

That the protoplasm itself is changed is indicated by the fact that its staining reactions are different after the action of cold; while certain changes in optical appearance are also brought about by the same agent. The membrane about the egg is quite noticably different in the cooled eggs; it may be formed but slowly and imperfectly and when formed be changed so remarkably as to fuse with the membranes of other eggs, at least so the author interprets certain monstrous compounds of several eggs enclosed in a common membrane.

The spindels and their sharply marked groups of chromosomes appear in the cooled eggs in quite different guises. The chromatic material may remain in long threads with irregular thickness instead of assuming the characteristic two groups of four sharply circumscribed rods. The number of the chromatic elements is also changed in these abnormal eggs. The achromatic filaments of the spindles assume the most peculiar arrangements in double strands or sheafs, or in crossing

[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts, reviews and preliminary notes may be sent.

[2] Archiv. f. Mik. Anat., Feb. 1895.

X-shaped bands, or in multipolar spindles. In some, the appearances point to an active migration of the chromosomes inducing a stretching or dragging of the achromatic filaments.

Many remarkable perturbations appear in the formation of the polar bodies. Contrary to the rule, in Ascaris the first polar body may divide after its extrusion. The polar bodies may be exceedingly large, appearing like blastomeres, and contain more than their share of chromosomes. In one case the polar body had taken all of the eight chromosomes, leaving the egg with the sperm only.

The pronuclei are increased in number when the chromosomes that should enter the polar body remain behind in the egg, since they are modified into small nuclei.

In the first cleavage spindle the number of chromatic elements may be greater than normally results from the fusion of one male and one female pronucleus.

It is thus evident that very abnormal processes may take place in the eggs of Ascaris when exposed to low temperatures.

In attributing so much to the action of cold it must not be forgotten that many such abnormalities have been found in eggs that had never been exposed to such temperatures; it is difficult to say just what are the limits of the "normal" processes occurring under the average conditions.

Isolated Blastomeres in Ascidians.—Hans Driesch[3] has applied his experimental methods to the eggs of the Ascidian *Phallusia mammilata* and found here, as in the echinoderm, that an isolated blastomere may form a complete individual.

When the eggs are shaken in water for only twenty-five seconds some of the blastomeres are so changed that they die and remain as inert masses inside the egg membrane, while the other blastomeres continue to develop. In this way a complete larva may be formed within the egg membrane and adjacent to the dead blastomeres.

Such larvæ arise from one of the first two cleavage cells and are about half the normal size. Otherwise they are like the normal larvæ in being perfect and complete individuals, except that the sense organs and adhesive organs may be in part deficient, as is the case in larvæ reared from whole eggs when exposed to adverse circumstances.

The larvæ are not at all half individuals but whole individuals.

In the cleavage of these separate blastomeres there is never any arrangement of cells to represent half the normal state: the cells form a

[3] Archiv. Entwicklungsmechanik. March 8, 1895.

solid aggregate and do not appear as open or half blastulæ: nor is there any peculiarity about the gastrula stage except its small size. One of the first few cells forms an irregular solid mass by cleavage; one of the first four and also three of the first four cells when left alive also form a compact mass that does not represent a half, a quarter or a three-quarter indivldual, but a whole one.

There is thus no semi-morula.

The chorda dorsalis is like that of a complete egg larva and not a half structure.

The author thus adds the ascidian to the echinus, frog, fish, medusæ and siphonophores as cases in which an isolated blastomere has been found to produce, not a partial, but a complete individual.

It will be remembered that Roux, in the frog, and Chabry,[4] in the ascidian; as well as Chun, in the ctenophores, find cases where an isolated blastomere does not make a complete individual but only a half or a partial one.

The results obtained by Chabry are in Driesch's opinion the same as those he himself has just obtained, though otherwise interpreted by Chabry, Barfurth and Roux.

Considering the differences in the methods employed by Chabry and Driesch we can scarcely expect a very close agreement in the results. Chabry carefully thrust a fine needle into one cell and left the other little disturbed. Driesch violently shook both cells so that one did not continue to live and the other, its equal, must have been much changed in its relation to the first cell as well as internally altered by the mechanical jar.

Frogs' Eggs in Salt Solution.—Professor Oscar Hertwig[5] has applied the method first used by T. H. Morgan in the study of the frog's egg to a more detailed examination of the abnormal results following when the eggs are kept in water containing common salt.

He finds that when eggs of *Rana esculenta* or *R. fusca* are put into water containing from 1 per cent to 5 per cent sodium chloride they develop abnormally; in the stronger solution they are soon killed, in the weaker not for several days.

Larvæ that develop in a 6 per cent solution of salt are abnormal only in the remarkable failure of the blastopore to close, as already noted by Morgan, and in the failure of the medullary folds to close over in the middle region of the brain.

[4] American Naturalis., July, 1892.

[5] Archiv. f. Mik. Anat. 16 Feb., 1895.

The action of weak salt solution is thus apparent as a partial inhibition of the normal developmental processes.

A considerable part of the paper is taken up with a consideration of the differences of view between Weismann and Hertwig, and the application of these new facts to the epigenetic conception of development.

Stimuli in Embryology.—Curt Herbst[6] reviews all the various forms of movements that are called forth in the lower animals and in plants by the action of heat, light, chemical bodies, etc., and known commonly as thermotaxis, phototaxis, chemotaxis, etc., and then advances a plea for regarding such responses to stimuli as important factors in the development of the individual.

Physiological stimuli are thus to be regarded as important factors in the processes of animal ontogeny. Just as a plant or animal cell may move to or away from the source of light, heat or chemical action and just as a plant may bend toward or away from such agents or respond to gravity or to moisture, so, Herbst thinks, may cells and organs in the embryo move or change form in response to various stimuli.

He would thus explain many well known facts; the migration of nuclei to the surface of an insect egg may be the result of positive ærotaxis, that is, the response of the nuclei to stimuli coming from the more abundant oxygen near the surface of the egg. The movements of vitellophags likewise may be the results of definite stimuli.

In later stages the remarkable collecting of mesenchyma cells to invest nerve processes, etc., that is, the formation of the sheath of Swan and the neurilemma as well as the coats of blood vessels may again be due to migrations under the directive influence of stimuli. Even the outgrowth of nerve fibres to the end organs (generally regarded as actually taking place) may not be along the lines of least resistance but controlled by directive stimuli.

All this, it will be observed, is an outgrowth of the observations upon lithium salts and echinoderm larvæ noticed in this journal for December, 1893.

[6] Biologische Centralblatt, Nov., 1894.

PSYCHOLOGY.[1]

Psychical Research.—Mr. Podmore has recently brought out a book in the Contemporary Science Series which seems to have a double object. In the first place, Mr. Podmore is himself fully convinced of the reality of "thought-transference" or "telepathy," as an, as yet, unrecognized agent in communication between mind and mind, and in this little book he marshals the experimental and spontaneous evidence for the hypothesis in an attractive and convincing manner. In the second place, Mr. Podmore thoroughly disapproves of the animistic and the spiritistic tendencies noticeable in much of current "psychical research" and is anxious to show that telepathy is sufficient to account for the phenomena upon which spiritism and animism depend. If this thesis can be made good it will certainly go far to accredit the cause of psychical research in the eyes of contemporary science. The telepathic conception as outlined by Mr. Podmore is sufficiently in line with current scientific conceptions to gain admission to their number, if sufficient experimental evidence is forthcoming to warrant it. It would be, perhaps, more exactly described as a species of "thought-induction," rather than as "thought-transference," and it does not seem hard, so far as *a priori* considerations are concerned, to conceive that the transformations of energy which, taking place in a given brain, are manifested as consciousness may, under conditions at present undetermined, induce in the brain of some other person similar transformations, accompanied by a similar mental state. The adoption of such a conception would not materially affect our general system of thinking in psychology or in other branches of natural science. But when we turn to animism or spiritism, the case is quite different. No amount of evidence will avail to persuade the average man of scientific training that the human consciousness can be separated from its material body and go to and fro upon the earth, becoming cognizant of things at a distance in space from its body and even of past and future events, and occasionally manifesting itself to other human beings as an "astral" form. And the notion that after death the personal consciousness still exists and can sometimes manifest itself to the living, is viewed with scarcely less disfavor. "Evidence" bearing upon such phenomena is usually thrown out of court without consideration.

[1] This department is edited by Dr. Wm. Romaine Newbold, University of Pennsylvania.

Mr. Podmore has been an active member of the English "Society for Psychical Research," since its founding; he was a personal friend of the late Mr. Edmund Gurney and is probably as much entitled to regard as an expert in the matters of which he speaks as any man living. Moreover, his cautious temper and shrewd common sense make him peculiarly well fitted to deal with questions in which the judgment of most persons is biased by either prejudice or superstition.

The first five chapters of the book deal with the experimental evidence, which Mr. Podmore thinks strong enough to establish the existence of some unknown method of communication. Then he turns to the spontaneous evidence, treating of such phenomena as coincident dreams, veridical hallucination, both individual and collective, cases of reciprocal telepathy, and of clairvoyance in the normal state and in trance. Much of the material adduced in these latter chapters cannot, I think, be fairly regarded as evidence for telepathy, or at least not for the type of inductive telepathy which the experimental evidence would lead us to infer. Much of it can be brought under any telepathic conception only by violent assumptions, and I cannot but feel that Mr. Podmore alleges it, not so much in proof of telepathy as in disproof of animism and spiritism, theories which these phenomena seem *prima facie*, to favor.

In his last chapter, entitled "Theories and Conclusions," Mr. Podmore indulges in some interesting speculations. "This close connection," he says, "of the activity of thought-transference with the subliminal consciousness, the consciousness which appears in hypnosis, and occasionally in dream-life and in spontaneous trance and automatism, may perhaps offer a clue to the origin of the faculty. For the future place of telepathy in the history of the race concerns us even more nearly than the mode of its operation; and we are led, therefore, to ask whether the faculty as we know it is but the germ of a more splendid capacity, or the last vestige of a power grown stunted through disuse. By those who view the matter simply as a topic of natural history, the latter alternative will be preferred. The possible utility of telepathy as a supplement to gesture, etc., at a time when speech and writing were not yet evolved, is too obvious for comment. Whilst, on the other hand, such a faculty can with difficulty be conceived as originating by any physical process of evolution in our modern civilization. But more direct evidence of the place of telepathy in our development is not wanting. For there are indications that the consciousness which lies below the threshhold, with which the activity of telepathy is constantly

associated, may be regarded as representing an earlier stage in the consciousness of the individual, and even, it may be, an earlier stage in the history of the race. The readiest means of summoning into activity this subterranean consciousness is in the hypnotic trance. Now, the consciousness displayed by the hypnotized subject includes, as a rule, the whole of the normal consciousness, and also extends beyond it. That is, the hypnotized subject is aware, not only of what goes on in the trance, but also of his normal life: when awakened, the events of the trance have passed from his memory and are not revived until the next period of trance. Our work-a-day consciousness would appear to be, in fact, a selection from a much larger field of potential consciousness. Or, to put it in another way, the pressure on the narrow limits of our working consciousness is so great that ideas and sensations are continually being crowded out and forced down below the threshhold. The subliminal consciousness thus becomes the receptacle of lapsed memories and sensations; and up to a certain point in the history of each individual these lapsed ideas can be temporarily revived. Long forgotten memories of childhood, for instance, can be resuscitated in the hypnotic trance, and ideas which have demonstrably never penetrated into consciousness at all can be brought to light by crystal vision, planchette-writing and other automatic processes.

"Again, one of the most marked characteristics of the subliminal consciousness, whether in dream, hypnosis, spontaneous trance, or in crystal vision and other automatism, is its power of visualization—a power which, as Mr. Galton has shown, and our daily experience proves, tends to become aborted in later life. And beyond these indications of memories lost and imagery crowded out in the lifetime of the individual, we come across traces of faculties which have long ceased to obey the guidance or minister to the needs of civilized man—the psychological lumber of many generations ago. Such, at least, it may be suggested, is a possible interpretation of the control frequently exercised by the hypnotic over the processes of digestion and circulation and the functions of the organic life generally. And the more doubtful observations, which seem to indicate the possession, by the sub-conscious life, of a sense of the passage of time and of a muscular sense superior to that of the waking state, may be held to point in the same direction.

"From such facts and such analogies as these it may be argued that telepathy is, perchance, the relic of a once serviceable faculty which eked out the primitive language of gesture, and held to bind our ancestors of the cave or the tree in, as yet, inarticulate community. Dr.

Jules Héricourt, indeed, goes further, and suggests that we find here traces of the primeval unspecialized sensitiveness which preceded the development of a nervous system—a heritage shared with the amoeba and the sea-anemone.

"On the other hand, it may be urged that our present knowledge, either of telepathy itself, or of the subconscious activities with which it is sought to link it, cannot by any means be held sufficient to support such an inference as to the probable origin of the faculty, and, further, that the absence of mundane analogies and the difficulties attending any such explanation yet suggested, forbid us to assume that the facts are capable of expression in physical terms.

"It is further urged that whilst the dependence of telepathy on any material conditions is not obvious, it is constantly associated, not only in popular belief, but in testimony from trustworthy sources, with phenomena which seem to point to supernormal faculties, such as clairvoyance, retrocognition, and prevision, themselves hardly susceptible of a physical explanation. This view has found its ablest exponent in Mr. F. W. H. Myers, and although Mr. Myers would himself readily admit that the evidence for these alleged supernormal faculties is not on a par with the evidence for telepathy, yet he maintains that such as it is it cannot be summarily dismissed. No doubt, if it should appear with fuller knowledge that there are sufficient grounds for believing in faculties which give to man knowledge, not derivable from living minds, of the distant, the far past and the future, it would be more reasonable to regard telepathy as a member of the group of such supernormal faculties, operating in ways wholly apart from the familiar sense activities, and not amenable like these, to terrestrial laws. Such considerations may, at any rate, be held to justify a suspension of judgment," and Mr. Podmore concludes with an earnest appeal for more careful experimental work.

I have given this passage *in extenso*, both on account of its interest from the point of view of biology and also on account of the clear statement which it makes of the "stratum" theory which is now accepted as a working hypothesis by many English psychologists, especially those interested in "psychical research." The theory is not without its advantages in explaining the phenomena of hypnosis and automatism, but it is not readily reconciled with our physiological knowledge. Moreover, it involves certain assumptions as to the continued independent existence of subconscious mental states which is wholly unjustified by the evidence. The analogous theory of "co-ordination" or "organization," propounded by Pierre Janet, seems to me

more consonant with the facts and with prevalent psycho-physiological conceptions. Neither theory, however, has as yet been much used by professional psychologists, just as the immense mass of phenomena which the theories would account for, is left unnoticed in most of our psychological text-books. There can be little doubt that when these phenomena are seriously studied by professional psychologists we shall find that the conceptions upon which the science is now based are in need of extensive modification. " Mind " will no longer be a simple, indivisible substance upon which the brain acts and which in turn acts upon the brain, but will be regarded as an exceedingly complex dynamic system, every part of which is what it is only by virtue of the then constituition of all other parts—a system capable of partial or total disintegration and of pathological integration. It is only by recourse to some such conception as this that we can hope to explain these hitherto unknown phenomena, and bring the laws of mind in line with the laws of its material basis, the brain.—W. R. NEWBOLD.

ARCHEOLOGY AND ETHNOLOGY.[1]

Notes on Yucatan.—The expedition sent out in January, by the University of Pennsylvania, had, for its object, the discovery of culture-layers in the caverns of Yucatan. It was thought that proof of man's antiquity in this part of Central America ought to be established by the discovery of refuse beds on the floors of conspicuous, easily-accessible caves, and a group of these shelters, situated in a mountain range, midway between many of the ruined cities, were chosen for exploration, as probably containing evidences of every race that ever visited the Peninsula.

When these cave floors were cut down to bed rock, and when the surface stratum of Maya occupation was sliced through, the work was expected to decide whether other earlier epoch-made refuse beds were to be encountered before the trenches reached rock bottom? This was the main question of the expedition, and the investigation which has, in a great degree, settled it, remains to be described in the report presently to be published by the University of Pennsylvania.

The thanks of the University are due Mr. John W. Corwith, of Chicago, for placing his time and means at their disposal in the under-

[1]This department is edited by H. C. Mercer, University of Pennsylvania.

taking. No less should acknowledgement be made to Dr. S. Weir Mitchell for advice and assistance in the outfit. Important cooperative aid has been furnished by Dr. William Pepper, President of the Association, by Dr. D. G. Brinton and Professor E. D. Cope; while the expedition owes its choice of the Sierra de Yucatan to the geographical help given it by Professor Angelo Heilprin, of the Academy of Natural Sciences of Philadelphia.

Certain notes, taken upon the journey, and not bearing directly upon the results of the work, may interest students. They recall an interesting conversation at Ticul, in February, with Herr Maler, the archeologist, who, coming to Mexico with the French expedition, has remained in Yucatan as a student of its antiquities, ever since.

Nothing, next to the stone work of the ruins themselves, so strikes the explorer in the peninsula as the remarkable predominance of pottery over all other relics of human handiwork. Herr Maler believes that much of the craft of the old earthenware might be relearned and recovered by a study of the work of the present Indian potters. Some of the pots were, he supposed, baked over the constricted calabash, now used as a water bottle, but on none were noticed traces of the potter's wheel. Pottery is found everywhere, but no hunting grounds have proved so rich as the *Chultun*, artificial, clock-shaped cisterns, built by the ancient Mayas, for catching rain-water. He who is staggered at the task of searching for sites of habitation in the stony, thorny, insect-haunted jungles, saves labor by climbing down into these round holes, so often seen in the woods and near mounds, now dry inside. When not repaired for modern use, their plastered floors generally contain two or more feet of rubbish, whence come many of the perfect vases, cups and jars which leave Yucatan. Chief among these is the wide-necked water jar, miniature models of which are sometimes found in the debris; the latter being probably playthings dropped by children into the cistern, and there lost beyond easy recovery in the deep water.

But the ruins themselves, by all means the most conspicuous relics of the past in Yucatan, visited and studied, perhaps, to exclusion of almost everything else, suggest a puzzling question which yet defies answer: How were the stones cut which surprise us by the richness of their ornament? Were the tools used random masses of similar material—chips of the old block, lavishly used to cut the parent stone? Were they the pitted hammer-stones of Mr. McGuire's theory, or chisels made of a harder rock? Were they implements of copper? Whatever any or all of them were, none of them have been discovered in

such a position as to prove their use. Yet, so immense is the amount of the Maya stone work, that the wonder increases as we think of it, and we fancy that the kind of tool we search for, battered and cast away, or well-worn on its cutting-edge, should be scattered about the ruins thicker than potsherds. The only reasonable explanation why not one single such tool has ever been found, is Herr Maler's—that the country is too much overgrown with thicket, too much obscured by uncultivatible stone heaps to make it easy to find anything.

Stone quarries near certain of the ruins where the native limestone had evidently been blocked out for building had been noticed by Herr Maler, and, though a modern quarryman rarely loses tools at the quarry, it is fair to suppose that a careful and prolonged search among the chips at these places might disclose one or two specimens, at least, broken or whole, of the cutting tool sought for. If the implements used were stone, the chance of finding a fragment, at least, is increased, since breakage would have disqualified many specimens for the work. While much stone chipping was undoubtedly done at the ruins, during building, and while there are probably stone-cutters' work-shops undiscovered close by the crumbling walls of Uxmal or Labna, it seems that an overhauling of these isolated quarries in the woods would easiest settle the vexed question.

Herr Maler had found no traces of earlier peoples in Yucatan, such as in Asia and Europe meet the explorer at ever turn. If a more ancient race of builders had preceded the Mayas, then the latter would have used again previously cut stones in their houses. But they did not; all the evidence showing that they originally dressed their building-stone from native rock. That the builders of the ruins lived chiefly on maize, beans, roots, melons and fruit he had little doubt. Flesh they rarely ate, and had no domestic animals except the dog. Of these he believed that there had been several indigenous kinds—one hairless, much used for food by the early Spanish explorers, existing still in Mexico, but now extinct in Yucatan. Another breed he supposed was hump-backed as is indicated by hump-backed figures of dogs, carved on the sixteenth century facade of Governor Montillo's house in Merida.

The explorer has not yet found much to astonish him in the graves of the ancient Mayas. Herr Maler says they lie thick near most mounds, rudely outlined with small rectangles of stone rather than indicated by earth heaps, so there is no way of discovering them when these little rows of stone become scattered, as is now generally the case, save at undisturbed spots in the remote wilds. Under them, skeletons, much decomposed, lie about three feet deep, sometimes in

boxes of undressed slabs, after the manner of the stone graves of Tennessee, but oftener in the open earth. If valuable trinkets of jadeite or nephrite and vases painted with hieroglyphs are not to be found in these tombs, we should hardly know where to look for them. But Herr Maler says that few graves reward search. Of hieroglyphs on vases he had seen several specimens, and showed me one such incised inscription at his house.

The mounds do not repay the explorer as they seem to promise. Instead of containing some tomb altar or enclosed chamber at their very centre, digging proves many of them to be heaps of loose boulders piled up for the purpose of erecting vaulted chambers on their sides and top. These ill-constructed structures have generally crumbled piecemeal into a loose talus that now forms the sides of the mounds, and the tumuli have become round, bramble-covered rubbish heaps, haunted by scorpions and garapatas. As a rule, with few exceptions, there are no graves inside the typical mound, which contains three tiers or steps of the buildings in question, each with its plastered terrace. In the debris of the old floors of these rooms, many interesting fragments of pottery, sometimes showing religious symbolism, sometimes imitating the forms of birds, monkeys and jaguars, have been found.

Of monkeys, Herr Maler believes that there are two or three species in Yucatan. One small earthen monkey head, which he showed me, was truer to nature and less grotesque than other miniature human busts in his collection. Of these latter, one hideous face had been presented to him by a Maya sorcerer at Bolon Chen, as a charm of great value. Obsidian flakes and flint knives, such as he showed me, were rare, since the modern Indians who found them, soon broke or lost them. The flint, of a creamy-white color, he had often found in the native state in swamps. Several earthen cloth stamps showed interesting curved designs, and two earthen whistles blew loud enough to have pleased a boatswain. Strange to say, he had but one arrowhead, but showed me several polished celts, probably of syenite or jadite, from Chichen-Itza, Cozumel, and other places. They were somewhat worn on the cutting edges, but, in my opinion, could not have been used to carve limestone.

Much light might be thrown on the history of the old inhabitants of Yucatan by a study of the modern Mayas, but Herr Maler supposed that the demonic beliefs and practices of the mystic brotherhood, known to students as Naguales, had faded away among the docile people of eastern Yucatan. The word Nagua, a familiar spirit in animal forms, is not used amongst them ; nevertheless, I suspect that interesting results

would reward the investigator of this subject who first mastered the language and then gained the confidence of these people.

—H. C. MERCER.

The Potters' Wheel in Yucatan.—While in charge of the Corwith Expedition of the University of Pennsylvania in Yucatan last month (March, 1895), and while studying the process of pottery making by modern Maya Indians at Merida, I saw a female potter reproduce the chief conditions of the potters' wheel by turning a wooden disc set on a board with her toes. The clay rested on the disc and received the impress of her tools and fingers while revolving. Though the disc was called, in Maya, *Kabal*, it may be doubted whether it is an inheritance by these Indians from their pre-Columbian ancestors and not derived from Spain; in other words, whether its present use demonstrates the existence, till now undiscovered, of the potters' wheel in ancient America.

Doylestown, April 13, 1895. —H. C. MERCER.

MICROSCOPY.[1]

Cytotropism of Cleavage Cells.[2]—The principle of the method employed by Roux is very simple; but the experiments require to be carried out with care, in order to exclude as far as possible sources ot error.

The eggs of *Rana fusca*, obtained from newly captured animals at the *beginning* of the normal period of spawning, furnished the best material for observation. Eggs obtained from animals kept separate and thus prevented from spawning at the normal time, proved to be quite unsatisfactory.

The phenomena of cytotropism are seen most readily between cells separated from the egg in the morula or blastula stage. The separation is effected by cutting or tearing the egg in an indifferent fluid, such as the white of a hen's egg, or a ½ per cent salt solution.

One requires for such experiments a small quantity (5–10 ccm.) of freshly prepared white of egg each day. This is prepared by filtering, in an uncut state, through a wad of cotton. The preparation must be perfectly clear.

The egg, in the morula or blastula stage, is first stripped of its gelattinous envelope, and placed on a circular glass plate, about 3 cm. in

[1] Edited by C. O. Whitman, University of Chicago. Contributions should be addressed to the editor.

[2] Wilhelm Roux, Ach. f. Entw'mech. d. Organismen, I, 1, pp. 44–48.

diameter; then covered with about 5 drops of the prepared white of egg, and torn open with two dissecting needles; or, after puncturing with one needle, cut with a small curved pair of scissors. The outflowing parts of the egg are then cautiously reduced in size by a few movements of the needles. The circular plate is then placed in a round glass dish (4–5 cm. in diameter) with a rim 1 cm. high, containing 10–15 drops of water—just enough to fill the space between the edge of the object-plate and the rim of the dish, but not enough to come in contact with the white. The purpose of the dish and the water is to check the evaporation of the medium in which the egg lies, and thus to guard as far as possible against concentration of the medium and currents in the same.

The dish offers the advantage that one, on interrupting the observation, can cover it and so protect the preparation against evaporation. Thus protected, cells may be kept alive in a suitable medium for one or two days.

The preparation should be immediately examined while in the dish with a low objective (e. g. Zeiss A). It is important that the table of the microscope and the object-plate bearing the preparation should be perfectly level.

The examination of isolated cells in an uncovered medium has the advantage that one can easily change the position of the cells with needles or other means. But it is indispensable for checking results to examine also preparations covered with a cover-slip. The cover-slip for this purpose must be large enough, so that at least two of the wax feet ($\frac{3}{4}$ mm. high) supporting it may fall on dry points of the object-plate, where they will firmly adhere and not allow the cover to slide.

A still more complete protection against currents in the medium may be had by having a moist chamber ground into the object-plate and covered with a large cover-slip. The bottom of the chamber must be flat and horizontal.

After separating the cells of an egg, one searches at first with a low power (Zeiss A) to find two cells separated from each other by a distance equal to, or less than, the radius of the smaller cell, and from all other cells by a distance not less than about double the diameter of the cells. No yolk substance should lie between or beneath the cells. Such a pair of cells having been found, higher objectives (Zeiss C or D) may be turned upon them and the cell so adjusted under the ocular micrometer that the line connecting their centres will fall lengthwise of the micrometer. In this position, one can easily see whether the cells move towards, or away from, each other.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

The U. S. National Academy of Sciences met in Washington, D. C., Tuesday, April 16th, 1895, and continued in session until Friday the 20th, inclusive. The following papers were read: "On Some Variations in the Genus Eucope," A. Agassiz and W. McM. Woodworth; "Notes on the Florida Reef," A. Agassiz; "The Progress of the Publications on the Expedition of 1891 of the U. S. Fish Commission Steamer 'Albatross,' Lieut.-Commander Z. L. Tanner, commanding;" A. Agassiz; "On Soil Bacteria," M. P. Ravenel (introduced by J. S. Billings); "A Linkage Showing the Laws of the Refraction of Light," A. M. Mayer; "On the Color Relations of Atoms, Ions and Molecules," M. Carey Lea; "Mechanical Interpretation of the Variations of Latitude," R. S. Woodward (introduced by S. C. Chandler); "On a New Determination of the Nutation-Constant, and Some Allied Topics," S. C. Chandler; "On the Secular Motion of a Free Magnetic Needle," L. A. Bauer (introduced by C. Abbe); "On the Composition of Expired Air, and Its Effect Upon Animal Life," J. S. Billings; "Systematic Catalogue of European Fishes," Th. Gill; The Extinct Cetacea of North America," E. D. Cope; On the Application of a Percentage Method in the Study of the Distribution of Oceanic Fishes:" (A) "Definition of Eleven Faunas and Two Sub-faunas of Deep Sea Fishes," (B) "The Relationships and Origin of the Carribeo-Mexican and Mediterranean Sub-faunas," G. Brown Goode; "On the Two Isomeric Chlorides of Ortho-sulpho-benzoic Acid," Ira Remsen; "On Some Compounds Containing Two Halogen Atoms in Combination with Nitrogen," Ira Remsen; "Presentation of the Watson Medal to Mr. Seth C. Chandler, for his Researches on the Variation of Latitudes, on Variable Stars, and for his other works in Astronomy"; "Biographical Memoir of Dr. Lewis M. Rutherford," B. A. Gould; "Relation of Jupiter's Orbit to the Mean Plane of Four Hundred and One Minor Planet Orbits," H. A. Newton; "Orbit of Miss Mitchell's Comet, 1847, VI," H. A. Newton.

The following officers were elected: President, Walcott Gibbs; Home Secretary, Asaph Hall; Foreign Secretary, Alexander Agassiz; Council, G. J. Brush, G. L. Goodale, S. Newcomb, B. A. Gould, Ira Remsen, O. C. Marsh.

The following were elected members: C. O. Whitman, Chicago; W. L. Elkin, New Haven; C. S. Sargent, Jamaica Plain, Mass.; W. H. Welch, Baltimore, Md.

Boston Society of Natural History.—March 20th.—The following paper was read: Miss Grace E. Cooley, "The Reserve Cellulose of the Endosperm of Seeds of the Liliaceae."

April 3d.—The following paper was read: Prof. Harold C. Ernst, "The Antitoxine of Diphtheria."

—SAMUEL HENSHAW, *Secretary.*

The Biological Society of Washington.—March 9th.—The following communications were made: Dr. C. W. Stiles, "A Double-pored Cestode with Occasional Single Pores;" Mr. Theo. Holm, "Oedema of Violet Leaves;" Dr. Geo. M. Sternberg, "Explanation of Acquired Immunity."

March 23d.—The following communications were made: Mr. Chas. T. Simpson, "On the Respective Values of the Shell and Soft Parts in Naiad Classification;" Mr. F. V. Coville, "Remarks on the List of Pteridophyta and Spermatophyta Growing Without Cultivation in Northeastern North America;" Dr. C. W. Stiles, "Two Cases of Adult Cestodes in *Sus scrofa*;" Prof. Joseph F. James, "Remarks on *Dæmonelix* and Allied Fossils." —FREDERIC A. LUCAS, *Secretary.*

SCIENTIFIC NEWS.

The province of Ontario is to have a great reservation for the preservation of its native animals and plants. The Algonquin Natural Park will comprise about a million acres of forest land. No hunting, trapping or destruction of animal life will be permitted within its precincts.

Dr. G. M. Dawson has been appointed to succeed Dr. A. R. C. Selwyn as Director of the Geological Survey of Canada.

An Austrian Expedition, under the direction of M. Julius von Payer, has been organized for Polar research. The present plan is to start for the eastern shore of Greenland in June, 1896.

A course of Popular Science Lectures, given under the auspices of the Ethical Society of St. Louis in the Grand Opera House of that city during the past winter, includes the following subjects: About Birds, or Life in the Air, Mr. Frank M. Chapman; The Native Races of North America, Mr. Frederick Starr; Explorations and Experiences in the Arctic Regions, Prof. Angelo Heilprin; About Fishes, or Life under the Sea, Prof. E. D. Cope.

The literature of games, a subject which has come prominently before the public since the remarkable exhibit of the games of all countries shown by Stewart Culin, in the Anthropological Building at the Columbian Exhibition at Chicago, will shortly receive a noteworthy addition in a work on "Korean Games," by Mr. Culin and Mr. Frank Hamilton Cushing, of the Bureau of Ethnology, Washington. The special field of Korea has been selected for illustration from the remarkable survivals that are found there. Mr. Edward B. Tylor bases his argument as to the Asiatic origin of Aztec culture largely upon the similarity of the Mexican game of Patolli with the Hindoo game of Pachsi. The resemblances which he noted will be shown to practically extend over all culture, and a theory of the origin of games formulated as the result of a searching examination of the games of all people. The book will be published by subscription as an edition de luxe, with twenty-two full-page colored plates from brilliant pictures by a skillful Korean artist, and with native sketches in black and white, of corresponding games of China and Japan.

Natural Science will be published hereafter by Messrs. Rait & Henderson Co., No. 22 St. Andrew St., Holborn Circus, London, England.

Professor James Dwight Dana, the eminent geologist, who for fifty years was a professor at Yale University, died at 10.30 P. M., April 14, 1895, of heart failure, aged 82 years.

Professor Dana had been ill for about eight weeks, but had, however, been able to be about on the streets attending to his usual routine. On Friday after being out for a walk he returned to his home slightly indisposed. The family physician, Dr. J. P. C. Foster, was summoned, but after making an examination said that the Professor's illness was nothing serious. Shortly after 10 o'clock that night (April 14th), however, there was a change in Professor Dana's condition and, becoming alarmed, the members of the household sent for the physician. Dr. Foster went immediately, but when he arrived at Professor Dana's residence he was dead.

Although well advanced in years Professor Dana was very active. He was a familiar figure about the streets of New Haven, as his daily routine was commenced with a visit to the post office for his mail.

When he resigned his position as professor of geology and mineralogy, the action was forced by his family because of the decline of his health. He had previously been asked by his friends in the University to give his work up, but he declined, preferring to continue. He was succeeded by Professor Henry S. Williams, of Cornell.

James Dwight Dana was born Utica, N, Y., February 13, 1813, and was graduated at Yale in 1833. He was appointed instructor of mathematics in the United States Navy, in which capacity he visited many remote parts of the world. In 1836 he returned to Yale as assistant in chemistry to Professor Benjamin Silliman. In 1838 he went with the United States exploring expedition to the Pacific, under the command of Captain Charles Wilkes. His reports on the Crustacea collected by the expedition, and on the geology of the regions visited are standard authorities on these subjects throughout the world. He did much important local work in Massachusetts and Connecticut. He was a defender of the doctrines of the permanency of continental nuclei, and of the glacier theory of the glacial phenomena of the Plistocene system.

In 1850 he became associate editor of the "American Journal of Science and Arts." The Geological Society of London in 1872 conferred upon him the Wollaston medal.

Professor Dana's works in book form include "System of Mineralogy," 1837; "Manual of Mineralogy," 1848; "Coral Reefs and Islands," 1853; "Manual of Geology," 1863; "Text Book of Geology," 1864; "Corals and Coral Islands," 1853; and "The Geological Story, Briefly Told," 1875.

A joint meeting of members of the University of Pennsylvania, the American Philosophical Society, and the Academy of Natural Sciences, was held in the hall of the Academy of Natural Sciences on the evening of Wednesday, April 10, in memory of the late Professor John A. Ryder. General Isaac J. Wistar presided, and Philip P. Calvert acted as secretary. Addresses were made by Dr. Harrison Allen on "Dr. Ryder's Relation to the Academy of Natural Sciences;" Dr. Bashford Dean, of Columbia College, on "Dr. Ryder's Work in the U. S. Fish Commission;" Dr. Horace Jayne on "Dr. Ryder and the School of Biology;" Professor E. D. Cope on "The Evolutionary Doctrine of Dr. Ryder;" H. F. Moore on "Dr. Ryder as a Teacher," and Dr. W. P. Wilson on "Dr. Ryder as a Collegian." The speakers all bore testimony to Prof. Ryder's merits as an investigator and as a teacher, and to his amiability and honesty as a man.

Charles D. Wolcott, of the United States Geological Survey, has had conferred upon him the Bigsby medal of the Royal Geological Society of England.

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Contents of THE MONIST for January, 1895.

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The Contributors, who are all Scholarly gentlemen and specialists will continue as before, but several new names will be added.

The following may be mentioned as having contributed to the Volume for '94.

Dr. D. G. Brinton, Rev. Wm. M Beauchamp, Prof. A. F. Chamberlain, Mr. James Deans, G. O. Dorsey, Dr. J. Walter Fewkes, H. C. Mercer, Mrs. Zelia Nuttall, C. Staniland Wake, Dr. Wm. Wallace Tooker, Dr. Cyrus Thomas. The Magazine during '95 will embrace different departments, and the following gentlemen will have charge and report all explorations and discoveries:

Rev. Wm. C. Winslow, D. D., L. L. D., Egypt.
Prof. T. F. Wright, Explorations in Palestine.
Henry W. Haynes, Paleolithics and European Archaeology.
Dr. A. S. Gatschett, Indian Linguistics.
Marshall H. Seville, Mexico and Central America.
Hon. James Wickersham, The North West Coast and Eastern Asia.

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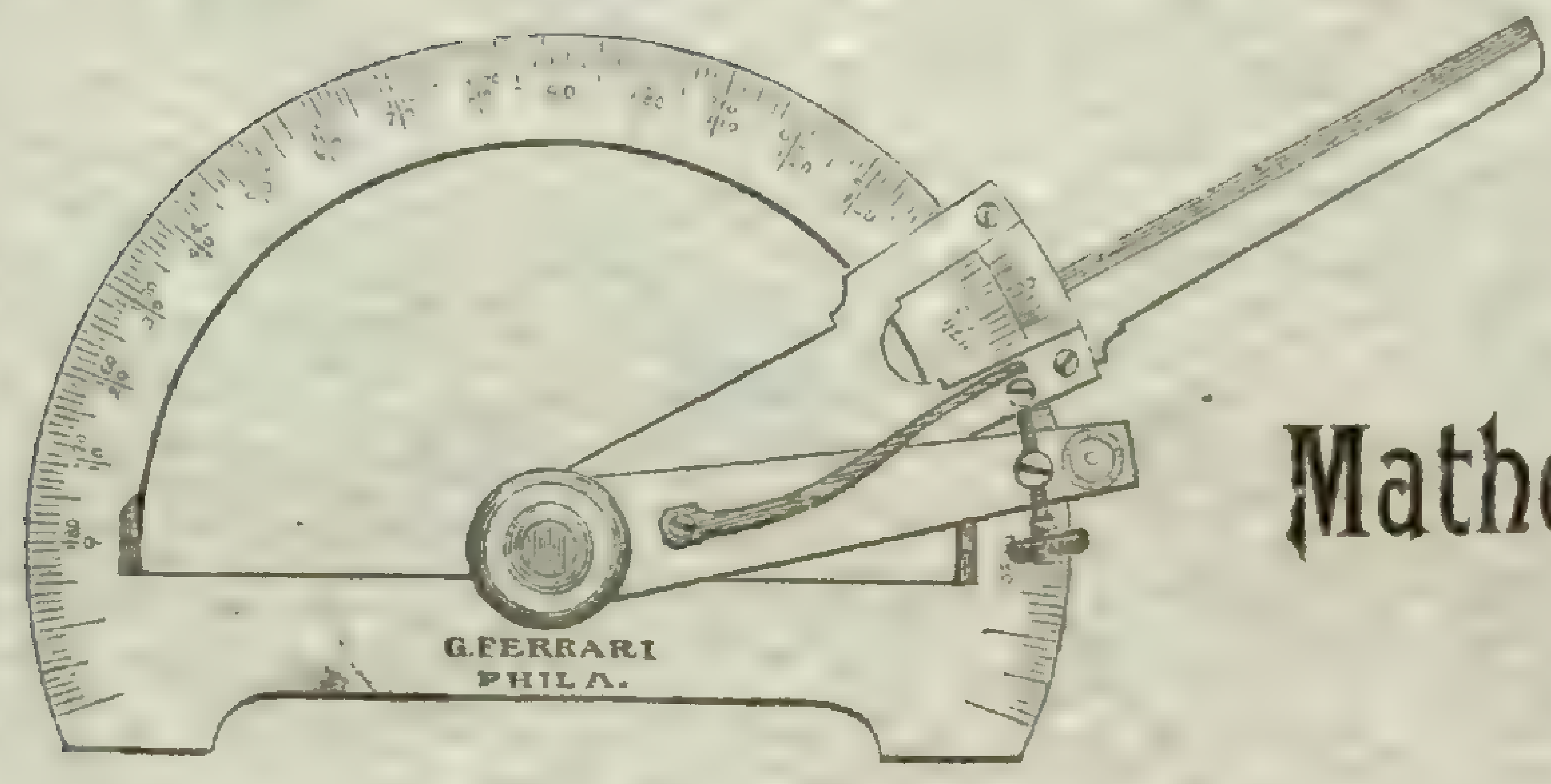

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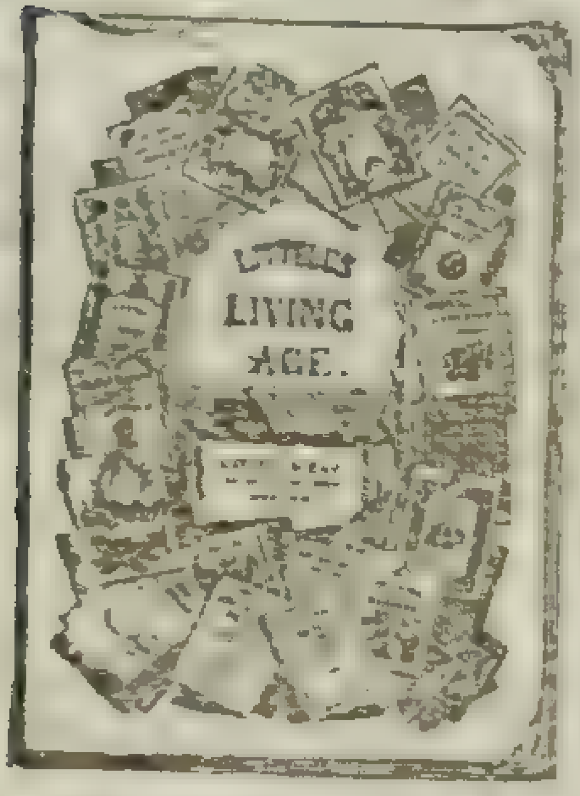

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Vol. XXIX. JUNE, 1895. No. 342

CONTENTS.

PAGE.
IS DAEMONELIX A BURROW? (Illustrated.) *Erwin Hinckley Barbour.* 517
ON SUCCESSIVE, PROTANDRIC AND PROTEROGYNIC HERMAPHRODITISM IN ANIMALS. *Thomas H. Montgomery, Jr.* 528
SPONGES: RECENT AND FOSSIL. (Illustrated.) *Joseph F. James.* 536
THE MOUTH-PARTS OF THE LEPIDOPTERA. (Illustrated.) *Vernon L. Kellogg.* 546
RECENT LITERATURE—The Cambridge Natural History—Marshall's Biological Lectures and Addresses—Butterfly Hunters in the Caribbees—L'Amateur de des Papillons—Monographic Revision of the Pocket Gophers—A Monograph of the Bats of North America. 557
RECENT BOOKS AND PAMPHLETS. 560
GENERAL NOTES.
Mineralogy.—Origin of the "Pflockstruktur" of Mellilite—Blowpipe Coatings on Glass—Use of Phosphorus in Studying Minerals of High Refractive Index—Chalcocite from Monte Catini—Diopside and Apatite from Zoptau—Serpierite—Lautite—Study of Optical Anomalies by Artificially Coloring—New Method of Illuminating in Photomicrographic Work—Chemical Behavior of Dimorphous Minerals—Pearls. 563
Petrography.—The Eruptive Rocks of the Christiana Region—The Massive Rocks of Arran—Migration of Crystals from a Younger to an Older Rock—News. 567
Geology and Paleontology—Niagara and the Great Lakes—Paleozoic Insects—The Phylogeny of the Whalebone Whales—Two New Species of Dinictis from the White River Beds, (Illustrated)—Geological News. 570
Botany.—Progress of the Botanical Survey of Nebraska—Pharmaceutical Botany. 580
Vegetable Physiology.—What becomes of the Flagella?—Perithecial Stage of the Apple-Scab Fungus—Poisonous Cactaceae—Rothert on Heliotropism—Austro-German Views on Botanical Nomenclature—Separation of Enzymes. . . . 583
Zoology—Habits of Limpets—Life History of the Lobster—The Gas in the Swim-bladder of Deep-Sea Fishes—A New Locality for Abastor erythrogrammus—The Cold-Storage Warehouse Cat—A New Harvest Mouse from Florida. . . 587
Embryology.—Grafting Amphibia—The Embryo of the Duckbill. 590
Anthropology.—The Antiquity of Man in North America—Paleolithic Man. 593
PROCEEDINGS OF SCIENTIFIC SOCIETIES. 600
SCIENTIFIC NEWS. 604

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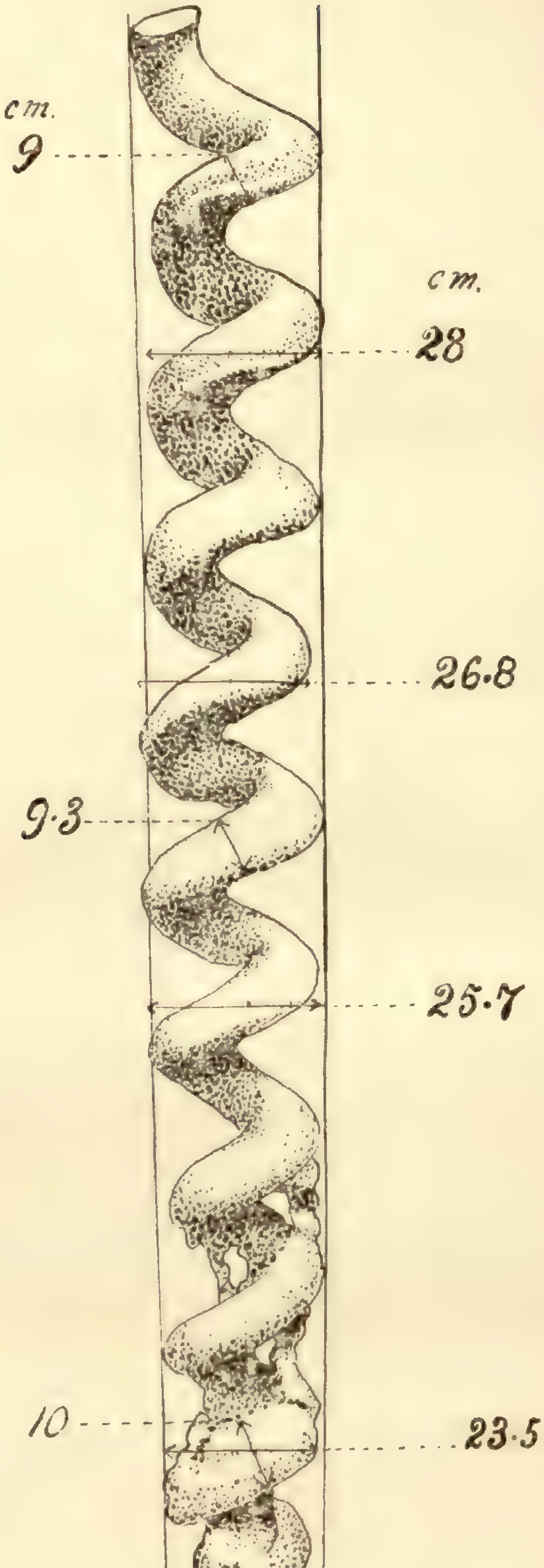

FIG. 2.

FIG. 1.—A typical Daemonelix without axis (The balance of this specimen is still in the rocks at Eagle Crag, Sioux Co., Nebr.). From a photograph of the specimen in the Morrill Collection, State Museum, University of Nebraska. (See Fig. 2.)

FIG. 2.—Diagrammatic figure of Daemonelix, giving measurements (See Fig. 1.) Height 2.3 meters.

THE

AMERICAN NATURALIST

VOL. XXIX. June, 1895. 342

IS DAEMONELIX A BURROW?[1]

A REPLY TO DR. THEODOR FUCHS.

BY ERWIN HINCKLEY BARBOUR.

Dr. Theodor Fuchs, criticises at considerable length the nature of Daemonelix as described by the author, in the University Studies, of the University of Nebraska, Vol. I, No. 4, July, 1892, under the title, 'Notes on a New Order of Gigantic Fossils.'

When the criticism first appeared it seemed so fraught with errors that they were counted its own best rebuttal, and no attempt to frame a reply was thought of. However, the author has several times of late been reminded that these errors might pass muster and become fixed in the minds of those, at least, who place too implicit reliance in authority. Therefore in all justice to himself and to those who have been entirely misguided and misinformed the author thinks it better, perhaps, to correct certain errors and inaccuracies.

After carefully describing the burrows of the supposed Miocene gopher, citing as important proof the rodent found inside of one specimen of Daemonelix, and after quoting Gesner on the 'Habit of the Pouched Rat' Geomys pineti, of Georgia, he writes:

[1] In Annalen k. k. Naturhistorichen Hofmuseums, Wein, 1893, Pages 91 to 94.

"I think we have before us all the essential elements of Daemonelix, and that accordingly we are justified in viewing these strange fossils as nothing else in reality than the underground homes of Miocene rodents, apparently of the family Geomyidæ.[2] Thereby it is very easy to explain why these spirals are found invariably in upright positions; why they are never prostrate, bent or broken. Also why, in spite of their massive size, no organic substance is present. But further the nature of the deposit in which these strange bodies occur sheds unexpected light.

"According to the representations and drawings of the author, these Daemonelix are in the Miocene deposits of the Bad Lands, and are not confined to one stratum but they occur in the entire mass of these layers, and one very frequently sees sides of the hills more than one hundred feet high, from bottom to top, studded with the screws, but especially with the root-stalk which projects everywhere on the sides of the hills.

"Under such circumstances these Miocene deposits can not possibly be those of an inland sea, but we must regard them as essentially continental formations for the most part of subäerial origin; the same as our Loess, as the pampas formation, and many similar ones.

"The assertion of the author, that the rock in which Daemonelix occurs is a very homogeneous fine sandstone, agrees very well with the above conception."[3]

[2] The same conception of Daemonelix could have been found in the American Naturalist for June, 1893 as proposed by Dr. E. D. Cope.

[3] Ich glaube, dass wir heir alle wesentlichen Elemente eines Daimonelix vor uns haben, und dass wir demnach berechtigt sind, in diesen sonderbaren Fossilien wirklich nichts Anderes als die unterirdischen Wohnungen miocäner Nagethiere, warscheinlich aus der Verwandtschaft von Geomys zu sehen.

Hiedurch erklärt sich ganz einfach, warum man diese Schraubenköper ausnahmslos in verticaler aufrechter Stellung findet, warum sie niemals umgefallen, umgebogen oder zerbrochen erscheinen, ebenso auch warum trotz ihres massigen Baues keine organische Substanz in ihnen vorhanden ist.

Aber auch auf die Natur der Ablagerungen, in welchen diese sonderbaren Körper auftreten, wird hierdurch ein unerwartetes Licht geworfen.

Nach der Darstellung und den Zeichnungen des Verfassers sind diese Daimonelix in den Miocänbildungen der Bad Lands durchaus nicht auf eine bestimmte Schicht beschränkt, sondern sie kommen durch die ganze Masse dieser Ablager-

The foregoing argument when summed up reads about as follows: Daemonelix is a burrow (false premise); burrows can not exist in water; therefore the Miocene of the Bad Lands are wind deposits (false conclusion). No valid argument can be based on the assumption of the point to be established and proved.

A premise, as the name signifies, is something antecedently established or proved, therefore the argument is based on the false premise that Daemonelix is a burrow, which is not an established fact, but is the fact which he is to establish. If the premise is false, so is the conclusion, and we find it remarkably exemplified in this case. The startling and extraordinary conclusion is, that the well-known region of the Miocene Bad Lands is a wind deposit, and not a water deposit, as it is known the world over to be. It is argument in a circle. It is not logical nor are the deductions geological. It is a pure assumption that Daemonelix is a burrow, but so easily is the mind led from pure assumptions to the conviction of their truth, that we find the author under consideration unhesitatingly pronouncing the well-known Miocene Bad Lands an aërial deposit, and denying that it is aqueous. That such a mistake could ever have been made is to be explained away on the ground of undue haste. No naturalist could deliberately pronounce our Miocene Bad Lands anything but water deposits.

Those famous Miocene beds are not wind deposits. They are not Loess. They are exactly what he says they are not, —water deposits. The Bad Lands are among the best known

ung vor, und man sieht sehr häufig Wände von mehreren 100 Fuss Höhe von unten bis oben von den Schrauben, noch mehr aber von den "Wurzelstöcken" erfüllt, welche überall an den Wänden hervorragen.

Unter solchen Verhältnissen können aber diese Miocänablagerungen unmöglich Ablagerungen eines Binnensees sein, sondern wir müssen sie der Hauptsache nach für continentale Bildungen ansehen welche, wahrscheinlich grossentheils subeerischen Ursprungs in ähnliche Weise gebildet werden wie unser Löss, wie die Pampasformation und viele andere ähnliche Bildungen.

Die Angabe des Verfassers, dass das Gestein, in welchem die Daimonelix vorkommen, ein äusserst homogener, feiner Sandstein ist, stimmt mit dieser Auffassung sehr gut überein.

and most celebrated formations in the world, and are recognized as stratified aqueous deposits by every geologist.

Unless the foregoing syllogism is right and all geologists wrong, then Dr. Fuchs' gopher is left to burrow and build its nest of dry hay in one or two hundred fathoms of Miocene water.

The White River tertiary is an extensive deposit covering parts of Nebraska, Dakota and Wyoming. The depth of the deposit was originally, and still is, nearly 1,000 feet in thickness, and the time required for its deposition is estimated at 25,000 to 30,000 years. It is so plainly stratified that inexperienced students, members of my geological excursions to these regions, could make out the strata and follow them with certainty at sight. They could recognize the Titanotherium beds, lower, middle, and upper, and follow them about as they would follow the lower, middle and upper boards of an ordinary fence. So with the Oreodon beds, Metamynodon sandrock, Protoceras and others. All is stratification there, and that too so strikingly and conspicuously that no one can overlook or mistake it. The Loess, or Bluff Deposits, at the best are but obscurely stratified. They occur in southern Nebraska, Iowa, northern Kansas, and Missouri, 200 or 300 miles south of the region under discussion.

No wind could ever have formed the perfectly stratified and minutely laminated deposits of the Bad Land region. It can be formed by the assorting power of water and by that only. It is, of course, true that modern winds are functional in producing certain local surface configurations, but primarily the deposit was aqueous throughout.

He says—"It is not clear what the author writes concerning the structure of the body of Daemonelix. According to him the same seems to be filled with fine tubes, which wind about each other and give the body a spongy structure, a circumstance which the author advances, and seizes upon as important proof of the organic structure of the bodies.

"It is difficult to discuss the subject without having seen the specimen. Typical Loess is also filled with fine tubes which

intertwining give it a tufaceous or sponge-like structure, yet it is in itself no organism."

The author is entirely cognisant of the fact that Loess is penetrated by tubes—but they are vertical rather than intertwining and ramifying,—whereby are produced lines of weakness in vertical planes. The result being manifest in the sides of cañons and bluffs which are as upright as walls. This it is that gives our bluff deposits their character. Of course, ordinary meteoric water, charged more or less with carbon dioxide, percolates readily through the porous Loess, where it finds superabundance of lime salts to be dissolved out. It finds easy passage through these tubes, and as evaporation goes on and the carbon dioxide is liberated, lime carbonate is deposited as a white lining to these tubes.

In the color, and in that alone, is there any similarity between the vertical tubes in Daemonelix and those of the Loess, although we are led to the inference that they are the same.

In chemical composition the two are totally unlike. The tubes of the Loess are entirely inorganic; those of the Daemonelix are entirely organic, as every section shows. There remains then not so much as a semblence of an analogy between the tubes of the Loess and those of the Daemonelix.

In reply to the description of the characteristic and very intricately tangled tubules on the surface of Daemonelix (Figured in Pl. III of the paper criticized) he asks, "Could not this tube structure originate from the dry grass of which the gopher built his nest?" It seems to me there are two very patent reasons why this can not be. In the first place the so-called hay is not confined to the region of the supposed nest, but covers every portion of the entire fossil. The burrow then in which the gopher presumably dwelt was literally tamped with fine hay from bottom to top. Where then did the gopher and his prolific family dwell?

In the second place, if it were hay, the microscope would easily recognize it. But to the contrary the microscope shows it is not hay, because there are no fibro-vascular bundles, which grass would of necessity show; nor is there a trace of the siliceous epidermal layer which would certainly be

preserved in grasses. Nor is the arrangement of cells that of hay, but it is instead that of soft parenchymatous tissue of sea-weeds or rootlets.

Fig. 3.—A typical Daemonelix with axis. From a photograph of a specimen in the Morrill Collection, State Museum, University of Nebraska. For measurements see Fig. 5.

As for the size and general appearance, I may explain here that these tubules are not unlike a tangle of rootlets in a flower pot.

In a semi-arid region, such as this, plants are variously modified to withstand drought. Some send down roots to unusual depths, and it often happens that wells are entirely filled with great masses of fibrous rootlets especially of the cotton-wood.

If we can conceive of the burrow being thus occupied it would agree much better with its general structure than hay. It would represent it still more closely if we conceive of a burrow, row, possibly abandoned, and subsequently lined by a felt of some imaginary fucoid. However, in view of all the facts, the foregoing seems untenable, and the author, although conceiving of the idea long ago, cannot believe this to be merely a vegetable lining to a burrow. Microscopic sections suggest the sea-weed, the structure being very simple. It is cellular but never vascular. It seems to me then that any attempt to show that these tubules are possibly hay, must miscarry.

"If the spiral is a filled up burrow so is the axis also, and one must admit that apparently the animal, after it had dug

the spiral burrow, in order to shorten the exit, dug yet another straight one."

"Possibly the animal used both burrows alternately, the comfortable winding one when it returned home with booty laden pouches; the shorter straight passage when it emerged light and unloaded."

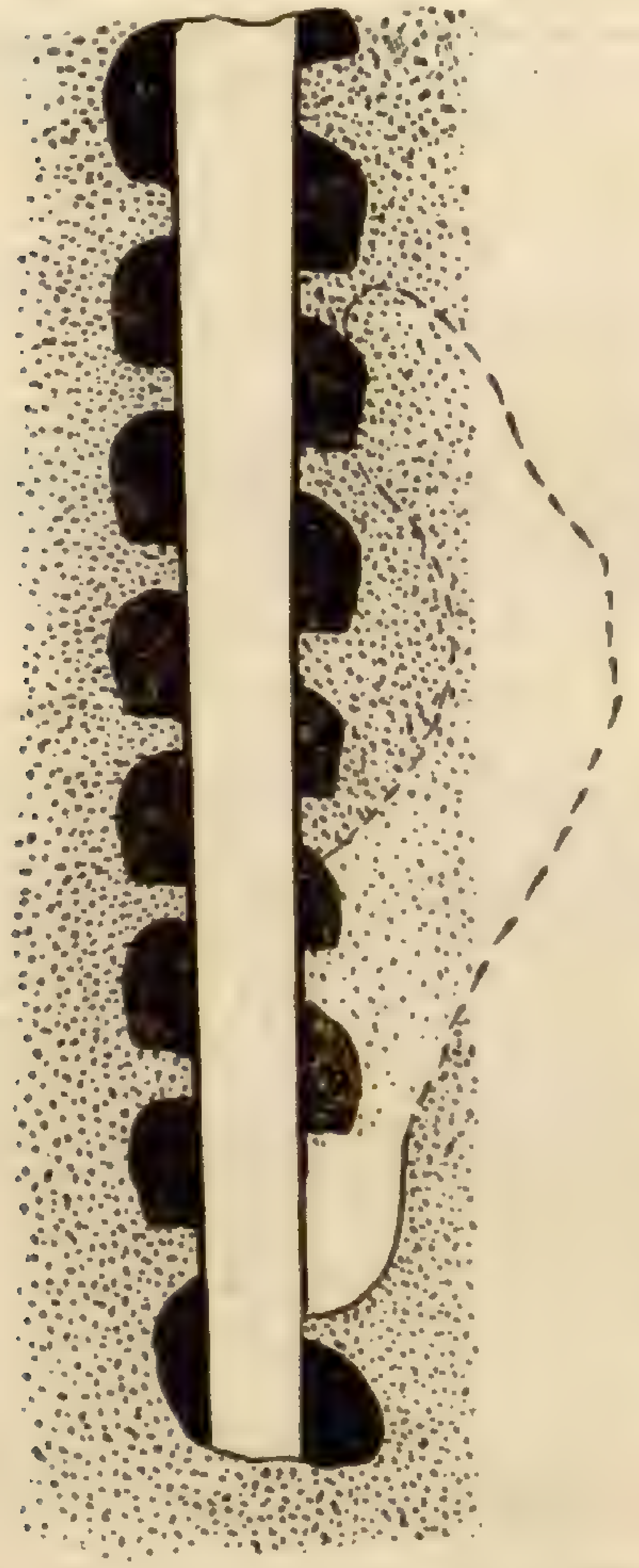

Fig. 4.—A diagrammatic figure showing the difficult, if not the mechanical impossibility of building a burrow in sand. The "Spiral Burrow" is colored black; the "Straight Burrow" is left white. The sand is represented by stippling.

"The author's observation agrees very well with this that each Daemonelix which has no central axis, but consists simply of a free spiral, has, as a rule, no transverse piece. One must certainly consider these as incomplete structures in which the side canal, with its nest and the central canal, are not yet finished."

It seems to me that the visionary argument in the foregoing crumbles as would such a burrow before it is half done. See Fig. 4. Conceive of a hollow rotunda in sand encircled by a spiral stairs and you have thought out a physical and mechanical impossibility. Grant that the sand was coherent enough to hold together till the burrow was done Can it be presumed for a moment that it could withstand the wear and tear of gophers climbing straight up this hollow passage? Yet the fossils show not a notched, scratched or rounded angle. If the Miocene gopher had burrowed in half lithified sandrock as coherent as that in which these fossils now occur, it could not resist the destruction which must result from gophers scurrying up and down its walls. But no specimen furnishes the slightest evidence of such wear.

But there are other facts militating against this burrow theory, among which the following may be mentioned. The tangled tubules which so plainly characterize the entire surface of Daemonelix often appear diffused in great irregular masses, and in broad sheets, in certain places throughout the sand rock in Daemonelix beds.

In the case of those which occur in thin sheets in cracks and fissures it is impossible that any animal ever burrowed there. Some of this plant structure then is unquestionably disconnected entirely from any burrow. What is true then of part of this organic structure may possibly be true of the whole.

It is very common indeed to notice offshoots from these corkscrews either running as supports from one coil up to the next (See Fig. 1) or running out irregularly into the surrounding matrix. These vary from the size of one millimeter to one or more centimeters and have been traced to a length of half a meter to a full meter or more.

Now it is perfectly apparent that no gopher could possibly have constructed these narrow tubes. Granting that he constructed the spiral tube how are we to account for these numerous offshoots which could not have been constructed by a gopher.

If this is in truth the work of a gopher then it must stand as a lasting monument to the genius of that creature which laid the lines of his complex abode with such invariable precision and constancy. If it were that of any of the lower forms the surprise would be less.

The difficulty alone of digging a spiral with a constant and invariable pitch seems entirely beyond the instincts of higher animals such as these quick and reasoning creatures. But besides the constancy and accuracy of pitch of the helix comes another element of great complexity, the helix tapers from top to bottom with such nicety that this animated instrument of precision would have to be sensitive to differences, not exceeding one millimeter for every 90°, in its course around the axis of the spiral. Is such precision to be expected of animals endowed with reason?

Without attempting to describe or discuss this point further the author has submitted certain figures which he believes will carry out the idea embodied in the foregoing much more tersely and emphatically than he could by verbal descriptions (See Figs. 2 and 5).

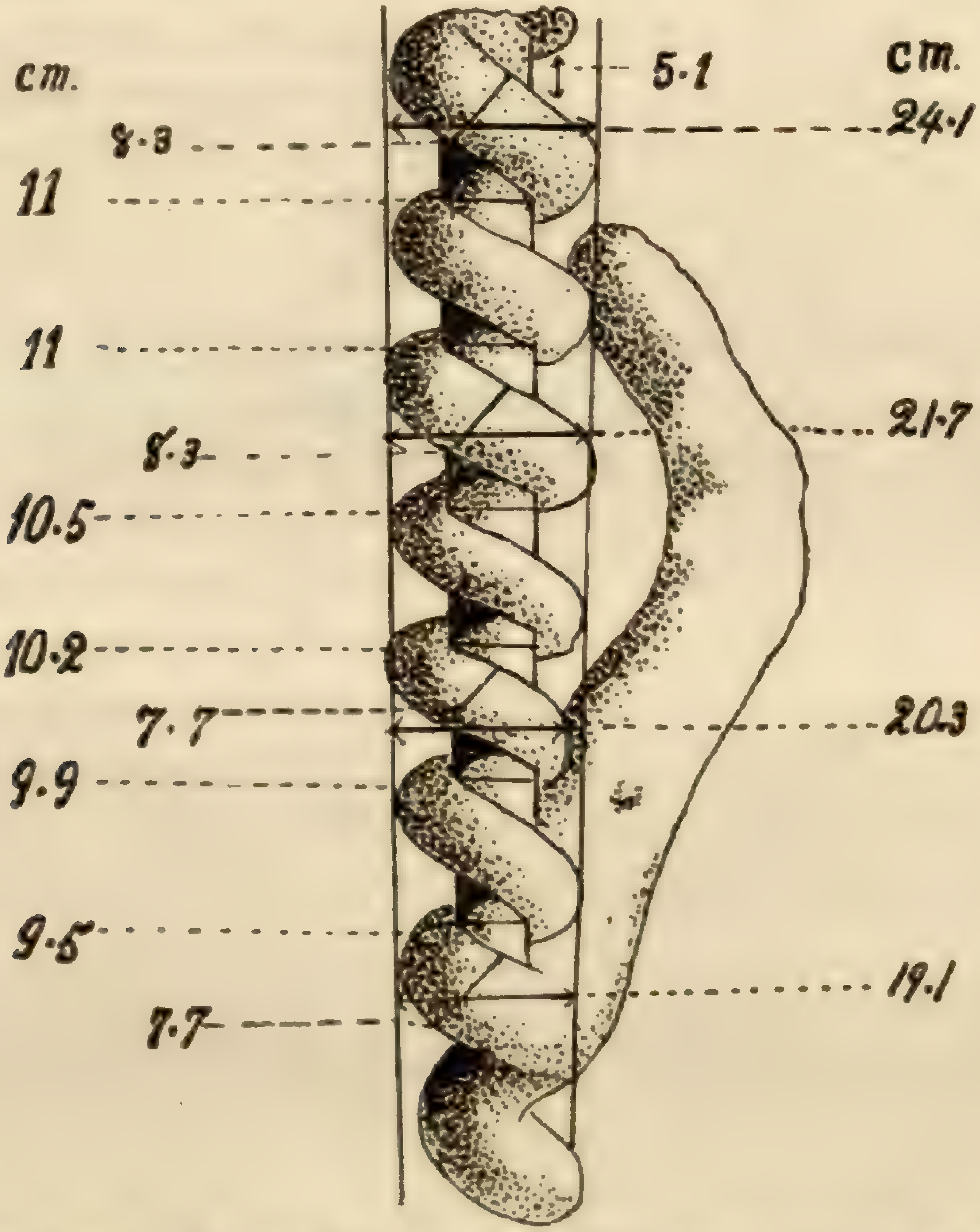

Fig. 5.—Diagrammatic figure of Daemonelix, giving measurements. (See Fig. 3.) Height 1.32 meters.

I believe that such precision could emanate only from the blind instinct of plants and lower animals unguided by reason.

In both papers (University Studies, Vol. I, No. 4, July, 1892, and Vol. II, No. 1, July, 1894) the author took pains to explain that he had found the skeleton of a rodent of exactly suitable size within the root-stalk at the base of a spiral. But in the next sentence he urged the recognition of the fact that at the same time one of his party, Mr. F. C. Kenyon, found the bones of a mammal as large as a deer, and altogether too large to have burrowed, yet it was likewise enclosed. The cork-screw

spread out and conformed to the shape and size of the bones exactly as though it had been some growth which encased them. It was accordingly suggested that possibly the small rodent had been enclosed likewise.

Touching this point Dr. Fuchs writes "In my examination I am further strengthened by finding on closer reading that the author had, at one time, found the complete skeleton of a rodent within a so-called root-stalk at its anterior extremity. The author finds it entirely inexplicable how a rodent could occur within a root-stalk and undertakes to decide the case by declaring that the rodent was submerged and that the plant had settled down and completely grown around its skeleton. I believe, however, that the author had at hand the builder of Daemonelix."

Possibly this may be so. Certainly the author conceived of the idea months before it was published that there was such a fossil in existence. But in all justice, Dr. Fuchs should have mentioned the larger skeleton also. The smaller skeleton was enclosed within Daemonelix, so was the larger. Whatever is proof in case of one ought to hold with the other, or at the least ought to have some weight.

But this much is certain that no 100 centimeter Artiodactyle Ungulate can burrow in a 20 centimeter hole. That is to say the mere fact of finding bones thus encased is not in itself unconditional proof of a burrow.

Some may raise the objection that possibly the bones of this large Artiodactyle were deposited in the sand long before the gopher dug his burrow, and that it is merely an accident that the gopher's hole passed through, or in the vicinity of, the skeleton deposited there. Granting that this is so, then we have to face this condition; the gopher in digging his burrow, dug straight through this large skeleton, through vertebræ and limb-bones alike, and yet they are not disarticulated. The joints, to the metatarsals, are in place and the zygapophyses of the vertebræ are locked in their original position.

Now can any one conceive of the possibility of a gopher digging a 20 centimeter hole straight through such a skeleton yet leaving it entirely articulate. At the least it is improbable,

and as I believe is impossible. However, if it is a possible case then it brings us to another condition; sedimentation must have gone on indefinitely long, the bones of the large animal were buried and covered by unknown feet of superimposed sediments, then the ancient lake was drained, erosion went on for an indefinite period cutting the surface into its present hills and valleys.

All this brings us then from Miocene to recent time, for it was in recent time, according to this, that the gopher must have dug his burrow through the bones of this old-time Artiodactyle. But it must be borne in mind in this connection that all these burrows are fossilized at the present time, and that the sand in which they occur is sandrock at the present time and must have been sandrock before the gopher dwelt there.

Can we believe that a gopher could excavate a burrow in rock too hard, often, even for our chisels and picks? Or has there been time for the fossilization of its burrow and bones on this supposition?

With the specimen in hand, grown over as it is with an organic network of tubules, the author can not believe that it can be accounted for in any other way than that already proposed; viz., that some organism quietly grew around these bones, conforming to their very shape and knitting them all together.

In still another case we found a small united radius and ulna in the matrix, on top of, and outside of, the root-stalk, just as if it had been deposited there as sedimentation went on One would naturally look for such bones within, not without the burrow; and on the bottom, not on the top.

The author would not be misunderstood in this reply. He does not deny the possibility of this being an old-time burrow, for such it may yet prove to be despite his fondest hopes and his avowed convictions to the contrary, and despite the very plant structure itself. But he does attempt to deny that the Bad Lands are Loess of æolian origin; that the tubes in Daemonelix are Loess tubes; that the tubules and plant cells are those of hay; and that any gopher, Miocene or modern, could possibly construct in fine sand a straight burrow inside a spiral burrow which could stand.

University of Nebraska, Dec. 1st, 1894.

ON SUCCESSIVE, PROTANDRIC AND PROTEROGYNIC HERMAPHRODITISM IN ANIMALS.

By Thos. H. Montgomery, Jr., Ph. D.

The term Successive Hermaphroditism has been introduced (Claparède, 9) to designate the kind of Hermaphroditism present in those animal forms, where the male and female gonads (germ glands) are in the adult separated from each other, and where the sexual products (sperma, ova) of the one sex develop earlier than those of the other. In all known cases of this form of Hermaphroditism, with perhaps the single exception of *Microstoma lineare* (Rywosch, 39, 40), the male products develop first.

Successive Hermaphroditism is prevalent in the *Plathelminthes* (with the exception of the Nemerteans) and especially in the group of the *Turbellaria.* In the *Cestodes* it has been observed in *Solenophorus megalocephalus* (Rodoz, 38) and by Zschhokke (48) in *Cestodes* which present a large number of proglottids. Ercolani (15) has proved this phase of Hermaphroditism among certain *Distomids.* In the *Turbellaria* it occurs in probably all the *Acoela* (Graff, 16). Among *Rhabdocoelida* in *Convoluta* (Claparède, 9), in *Macrostoma hystrix* and *Promeostoma ovoideum* (Graff, 16), in *Graffilla muricicola* (Ihering, 18, Böhmig, 5) and in *G. brauni* (Smidt, 42), in *Prorhynchus* (von Kennel, 19, Moore, 32a). According to Du Plessis (13) it occurs in *Plagiostoma lemani*, though the accuracy of this observation has been doubted by Graff (*l. c.*). As mentioned above, in *Microstoma lineare* according to Rywosch (39, 40) the female organs develop before the male organs. Hallez (17) has observed this phase of Hermaphroditism in a number of the *Tricladidea*, and Loman (29) in *Bipalium.* It is the rule in the *Polycladidea* (Lang, 24). Finally, Successive Hermaphroditism has been noted among the *Mollusca* in *Entoconcha* (Müller, 33), and in the *Anatinacea* (Babor, 2).

In the case of Protandric Hermaphroditism the male and female gonads are united together into a single herma-

phrodite gland (ovotestis), but the male elements are developed earlier than the female. Protandric and Successive Hermaphroditism are, however, not to be very sharply distinguished from one another. For example, in the Molluscs, where both these phases occur, we find all intermediate stages between (1) forms having a simple ovotestis, in which the male elements develop first (e. g. *Ostrea*); (2) forms, where in certain acini of a protandric ovotestis only male, in other acini only female elements are produced (e. g. *Lobiger*); and lastly (3) in forms where there are two or four separate genital glands, the male elements developing first (e. g. *Entoconcha* and the *Anatinacea*). According, though it is not proved that in all cases Successive Hermaphroditism has been evolved out of Protandric Hermaphroditism, this has very probably been the case in certain animals, as *Entoconcha* and the *Anatinacea*, which shows that these two phases of Hermaphroditism are closely connected with each other.

Protandric Hermaphroditism has been demonstrated in representatives of a large number of groups. Among sponges in *Aplysilla violacea* (Lendenfeld, 26) and *Amorphina coalita* (Topsent, 44); I wish here to express my thanks to my former teacher, Prof. F. E. Schulze of Berlin, for calling my attention to these two references. Among *Nematodes* in *Allantonema mirabile* (Leuckart, 28), and *Filaria rigida* (zur Strassen, 43). Among *Nemertinea* in *Tetrastemma kefersteini* (Marion, 30), and observed further by me (32) in *Stichostemma eilhardi*. According to Korschelt's (21) observations it is present in the polychæte Genus *Ophryotrocha*. Wheeler's (46) account of the development of the gonads of *Myzostoma* would show that in this form Protandric Hermaphroditism exists, though Beard's (3, 4) studies on the contrary would explain the state of affairs on the "complemental male" theory. Among Isopod Crustacea in three genera of the *Cymothoidæ*,-*Nerocila*, *Cymothoa*, *Anilocra* (Mayer, 31). Among *Echinoderms* we find it in *Asterina gibbosa* and *Amphiura squamata* (Lang, 25). But especially in the *Mollusca* is Protandry of frequent occurrence. So it occurs in the *Solenogastra* (Wiren, 47, Koren, and Danielssen, 20). In the *pulmonate Gasteropoda* in *Lymnæus* (Eisig, 14),

Agriolimax agrestis L. and *A. melanocephalus* Kal. (Babor, 1, 2). In the *Opisthobranch Gasteropoda* in *Cymbulia* (Leuckart, 27), *Cymbuliopsis* (Peck, 35); *Desmopterus papilio* (Chun, 8); *Lobiger, Clio striata, Clione, Eolis* and *Elysia* (Pelseneer, 36, 37). Among the *Lamellibranchiata* in *Ostrea* (Davaine, 12, confirmed by Van Beneden, 45). Finally, among the Vertebrates in *Myxine* (Cunningham, 11, Nansen, 34), and in *Chrysophrys* (Brock, 6).

Proterogynic Hermaphroditism is the term applied to the case of those animals, where the male and female gonads are not morphologically separate from each other, and where in the single ovotestis the female genital products are developed before the male products. It is much more restricted than the two other phases of Hermaphroditism under discussion, thus far having been observed only in pulmonate Gastropoda,—*Limax maximus* L., *Malacolimax tenellus* Nils. (Babor, 1, 2), *Agriolimax lævis* Müll. (Brock, 7; Babor, 1, 2); and among the *Tunicata* in *Salpa* (Krohn, 23; Korschelt and Heider, 22).

Since now both Proterogynic and Protandric Hermaphroditism may occur in the same genus (e. g. *Agriolimax*), these two phases of Hermaphroditism are probably closely allied. And as there exists in some cases of Protandry a cycle of development, where the individual is first male, then hermaphrodite, then female (e. g. *Stichostemma*); so there is present in some cases of Proterogyny (e. g. *Agriolimax lævis*) a similar ontogenetic cycle, only reversed, by which the individual is first female, then hermaphrodite, and lastly becomes male. In fact, I think that I am justified in concluding, that the three forms of Hermaphroditism, which form the subject of the present paper, are closely connected with each other, and their differences are more of degree than of kind.

What light does the consideration of these three phases of Hermaphroditism throw on the much discussed question,—whether in the Metazoa the hermaphroditic or whether the dioecious state should be regarded as the more primitive? Now we have found that in each phase, the products of the one sex develop earlier than the products of the other sex; accordingly, judging from the well known biogenetic law, that the

ontogeny repeats (to some extent at least) the phylogeny, we may logically conclude that the Hermaphroditism of those *Metazoa*, which present one or another of these phases of sexual development, has been secondarily acquired. This seems to me to be the only adequate explanation for such cycles of sexual development in the individual. Since the object of my present paper is only to discuss the meaning of these three kinds of Hermaphroditism, it would be irrelevant to bring into consideration the many other reasons tending to show that Hermaphroditism in the *Metazoa* is a secondarily acquired state. But this much may be remarked, that according to our argument all animal forms which present one or another of these phases of Hermaphroditism have been developed from dioecious ancestral forms; and it must be left to future investigators to show in how many forms these phases are actually present, that is, whether or not all hermaphrodite *Metazoa* are either protandric, proterogynic, or successively hermaphrodite, and whether or not all hermaphrodite *Metazoa* are, therefore, to be regarded by the argument above as having been derived from dioecious ancestors. Finally in those forms where the individual is first male (or female), then becomes hermaphroditic, and lastly female (or male), we may conclude that the hermaphrodite species in question has not only been evolved out of dioecious ancestral forms, but is perhaps also tending to become dioecious for a second time.

There now arises the question: on which sex has the hermaphroditic state been superimposed? In the case of protandric hermaphrodites, since here the male stage appears first in the ontogeny, one must suppose that it has been imposed on the male,—that ova have appeared in the testicle, and the individual has thus become hermaphroditic. Similarly, in all cases of Successive Hermaphroditism with perhaps the exception of *Microstoma lineare*, we may consider that here too the Hermaphroditism has been superimposed on male individuals. In proterogynic forms, on the contrary, the Hermaphroditism has probably been imposed on the female, since here the female stage appears ontogenetically first. Pelseneer (37) while arguing that all hermaphrodite molluscan forms have

been developed out of dioecious ancestors, endeavors to prove, that hermaphroditism here has been superimposed on the female sex alone. He bases his assumption on the fact, that in certain normally hermaphroditic Gastropods (*Cymbuliopsis, Clio striata, Helix aspera, Agriolimax lævis, Arion intermedius*) whenever an individual is found which is not hermaphroditic, it possesses the female organs only. But *Agriolimax lævis* is certainly, and *Helix* and *Arion* probably, proterogynic, so that the individuals found with female organs only, should simply be considered as individuals in the early stage before male organs have appeared. *Clio striata* on the contrary, and probably *Cymbuliopsis*, are protandric, accordingly the annotated female individuals of these two species should be regarded, as being individuals which have passed through both the early male and the hermaphroditic stage, and through the loss of all male elements had become entirely female. Thus Pelseneer's five cited cases are to be explained as being individuals in certain stages of ontogenetic sexual development, and are not to be referred to Atavism. To summarize, I agree with this zoologist that Hermaphroditism has been evolved out of the female state in all proterogynic forms, but in opposition to his views, hold that in the case of protandric forms Hermaphroditism has been superimposed on the male sex.

As to those forms, in which so-called "complemental males" are present (e. g. the *Cirripedea*, and, perhaps, *Myzostoma*), I think that these too may come under either the conception of Protandric or of Proterogynic Hermaphrodites. The complimental males could then, in the case of Protandry, be regarded as individuals which had not yet become hermaphroditic; and in the case of Proterogyny, as individuals which had passed through the ontogenetic female and hermaphroditic stages, and had become entirely male. It is perhaps more probable that Protandry and not Proterogyny has been the method of development in the Cirripedes. However, until our knowledge of ontogeny of the Cirripedes has advanced much further than its present state, the suggestions here advanced to account for the existence of complemental males can only be regarded in the light of a hypothesis.

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SPONGES: RECENT AND FOSSIL.

By Joseph F. James, M. D., M. Sc., U. S. Dept. Agriculture, Washington, D. C.

A sponge, while one of the lowest forms in the scale of animal existence, belongs to a class ranging back in time almost to the beginning of organized life. As known in a living state it is an aggregation of individuals, each one minute, but together forming a body often of considerable size. Without power of locomotion; without any differentiation of parts such as obtain in animals of a higher grade, it yet manages to subsist in a great number of places and in the greatest variety of forms. Geology tells us the family has persisted upon the earth since the earliest time of which there is any record; and at no period has it been absent from places suited for the growth of its various members. A few words about living sponges may make plainer a short account of some of the fossil forms.

The modern sponge is most familiar as an article of toilet use, varying in size from one as small as an egg to one that would fill a half-bushel basket; and differing in texture as much as in size. The gathering of this sort of sponge is a distinct trade, pursued by fishermen in many quarters of the globe, but especially in the Mediterranean. The value of the fisheries for a single year (1871), as represented at a single port (Trieste), was over half a million dollars ($540,000).

The examination of one of these sponges of commerce shows a porous structure, with a vast number of holes, some large, some small. The large ones are called " oscula." This porous body is but the skeleton, the animal matter, a sticky, gelatinous mass, having been destroyed in preparing the sponge for commercial purposes. If one of these aggregations of animalcules be studied in a living state, an interesting sight is visible.

A stream of water enters the smaller pores, is carrried by the branching canals through the interior, and is ejected from the larger openings or oscula. (Fig. 1.) The ingoing streams carry with them the food of the colony; the outgoing ones take away the waste or insoluble particles, and the water cleared of the food suitable for the growth of the individuals among which it has passed. The water is drawn into the sponge mass by the action of rapidly vibrating cilia or hairs, and it is forced out by the constant inflow thus created.

FIG 1. Portion of sponge, highly magnified, showing incurrent and excurrent streams. The arrows indicate the direction of the water. (After T. Rymer Jones.)

A close examination of the skeleton shows it to be made up of multitudes of fibres, sometimes calcareous, sometimes siliceous. In most instances siliceous spicules are found in great abundance, though these are, in certain forms, calcareous. The spicules are most diversified in form. Some are long, straight and bar-like, pointed at one or both ends or else club-shaped; some are provided with three, four, six or many branches; sometimes spines are produced, at the tips or on the sides;

sometimes there are developed at the top or bottom, cross-bars, or there is a cluster, curving upward or downward; some are

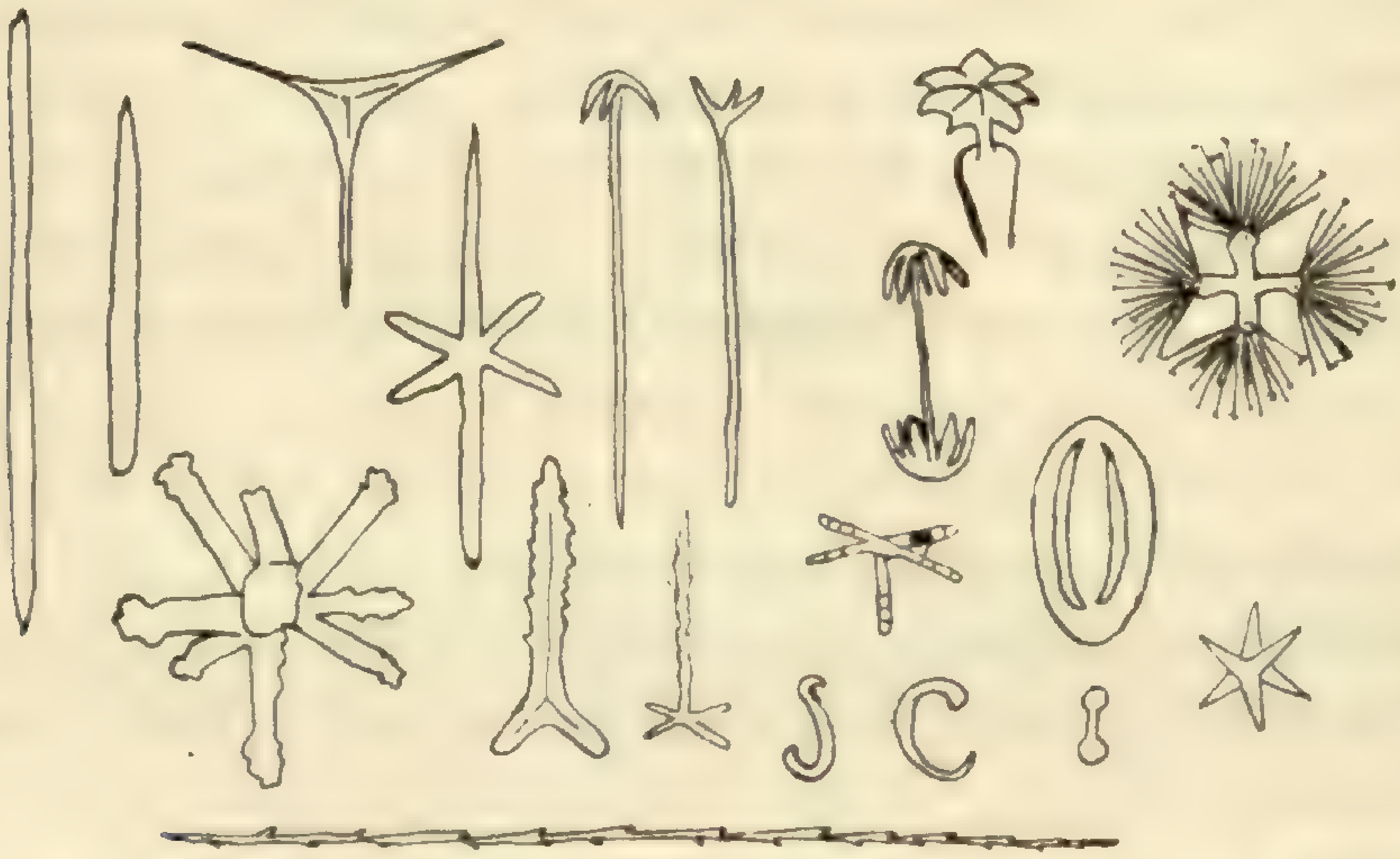

Fig. 2. Various forms of sponge spicules. (After Sollas).

shaped like harpoons, with spines along the sides, all pointing in one direction. Some are curved; some have an umbrella-like top; some are oval, star-shaped, or are developed in the form of a rosette (Fig. 2). Sometimes these spicules are simply scattered promiscuously through the fibrous net-work; but in other instances they become united during growth at their free ends, and a network is formed from which results such species as the beautiful Venus's Flower Basket sponge.

Each one of the spicules of a sponge originates in a single cell, within which it remains until fully grown. "During its growth the spicule slowly passes from the interior to the exterior of the sponge, and is finally (at least in some species) cast out as an effete product. The sponge is thus constantly producing and disengaging spicules; and in this way we may account for the extraordinary profusion of these structures in some modern marine deposits and in the ancient stratified rocks." (W. J. Sollas).

While the sponge as a mass does not show any differentiation into special parts or organs, there are frequently scattered throughout its tissues certain wandering amœboid cells. These seem to perform special purposes. Some act as scavengers; others as carries of nourishment; while some become

converted into sexual products. It is even supposed from the connection of certain cells by ganglia with groups of other cells, that there may be a few nerve fibres, with the power of converting external impressions into muscular movements.

The life history of sponges is, as yet, imperfectly known. Our knowledge can be given in a comparatively few words. Increase takes place by internal and external budding; by fission (division); and by sexual reproduction. In the method of increase by budding, a few cells become developed at some point, increase by general growth, bulge out from the cortex, and drop off to form a new colony. In internal division a mass of cells forms a globular cluster. The outer ones change so as to form an external sac. Under certain conditions the cells from the interior creep out from the enclosing sac, form a spreading mass, and give rise to a new colony. Sollas supposes these "gemmules" serve a protective purpose, and insure the persistence of the race, "since," says he, "they only appear in extreme climates on the approach of drought, and in cold ones on the approach of winter. As a secondary function they serve for the dispersal of the species; some are light enough to float down a stream, but not too far, so that there is no danger of their being carried to sea; others which are characterized by large air chambers, are possibly distributed by the wind."

Both sexes may occur in the same colony—though frequently one predominates—or they may be entirely separated. The ovum or female form develops from one of the wandering cells previously referred to, gradually increasing in size and finally passing into a resting state. The spermatozoan or male element is a minute oval or pear-shaped body with a long vibratile tail. The tailed bodies are also developed from wandering amœboid cells, each cell containing numbers of them. When mature, the spermatozoa rupture the walls of the sac where they are confined, and at a favorable opportunity enter and fertilize the ovum. After this occurs the egg begins to grow, the cells at either end assuming distinct characters. When mature, the new individual ruptures the cell wall, enters one of the canals ramifying throughout the sponge

body, and is carried out through the oscula by the out-flowing current, swimming and whirling about in a lively manner. It soon assumes a more spherical form, while a depression appearing at one end increases in depth until a cup-shaped cavity results. The young spore then settles on a rock or some other substance, mouth downwards, becoming fast to its future abiding place. It elongates and becomes a cylindrical larva; the depression at the upper end develops into an opening or osculum, and the last stage of growth of the sponge is entered upon. It has now simply to divide and increase in size to form the sponge as we know it. The process varies, of course, with different species, but the stages of egg, free swimming larva, attached larva and developed sponge are the same in all.

It is, of course, impossible to say that fossil species of sponges passed through the cycle which has been briefly described, although there is every reason to believe it to have been so. But of one thing we are certain, that in the sponges we have a group of organisms which has persisted under a great variety of forms through all the vicissitudes of the earth's career. Thousands of kinds have ceased to exist; hundreds have been preserved to us in the rocks of various formations. Yet with all the extinction that has occurred, there is not a single large group which has not both fossil and living representatives. It is, therefore, a most interesting group of organisms, and one which neither time nor changeed conditions has caused to disappear.

The oldest known series of fossil-bearing rocks in the world contains forms which belong to the sponges. Like low types that live at present, these early sponges were widely dispersed over the earth, and the same species occurs in rocks of Lower Cambrian age in Labrador on the eastern and in Nevada on the western side of the continent. One of the genera that seems to combine the features of the two great groups of corals and sponges, and whose position is, in consequence, still a matter of discussion, is known as *Ethmophyllum*. The species are simple, elongated, cup-shaped, turbinate or club-shaped; they may be curved or straight; ribbed, lobed or corrugated.

A thin membrane lines the inner and covers the outer wall, pierced by a great number of holes, while the two tissues are united by a number of septa. Dr. Dawson compares it to an

FIG. 3. *Ethmophyllum*, partly restored. (After Billings.)

FIG. 4. *Leptomitus*. (After Walcott.)

inverted cone, formed of carbonate of lime, with its point imbedded in the mud and the open cup above (Fig. 3). The lower part is composed of thick plates, enclosing communicating chambers. The cup expands above and the spaces between the two membranes are filled with sarcode or animal matter. Out from the pores projected innumerable pseudopodia, that served to convey food to the colony.

Another one of the sponges from the Lower Cambrian horizon is a member of the group to which the Glass-rope sponge belongs, and it seems to be almost the earliest progenitor of the group. It has been named *Leptomitus* (Fig 4) and consists of a long bundle of acicular threads. It represents, possibly, the anchoring body of a sponge similar to *Hyalonema* found at present in the eastern seas. In *Protospongia* is an example of a form with a very wide geographical range. It has been found in Cambrian rocks in England, in Norway and Sweden, in New Brunswick and in Nevada. The extension of this species over so wide an area is indicative of great similarity of conditions in widely separated countries. It indicates a sim-

ilarity in temperature, similar conditions of sedimentation, similar oceanic currents, and probably similar depths of water.

As time passes and we ascend the geological scale, the number and variety of genera of sponges increases. In rocks of Trenton age there has been found in a few localities in Kentucky, a form known as *Brachiospongia* (Fig. 5). It has a large, cup-shaped body, with an open, central cavity, and with from seven to thirteen arms radiating from it. No perfect specimen of this has ever been found, and the conditions of preservation have not been such as to favor the presence of the minuter features. The probabilities are that it grew on the ocean floor, fastened by a single point, with the open mouth of the cup above, and the so-called arms extending out in all directions. Its cruciform spicules ally it to certain modern living forms.

In rocks of later age occur interesting cylindrical or turbinate forms described originally as sea-weeds. The framework is in the form of a net with regular meshes, the threads crossing each other at right angles. Professor Whitfield says that the threads "are not interwoven with each other like basket work, or like the fibres of cloth, nor do they unite with each other as do vegetable substances; but one set appears to pass on the outside, and the other on the inside of the body. The threads composing the network vary in strength, and are in regular sets in both directions."

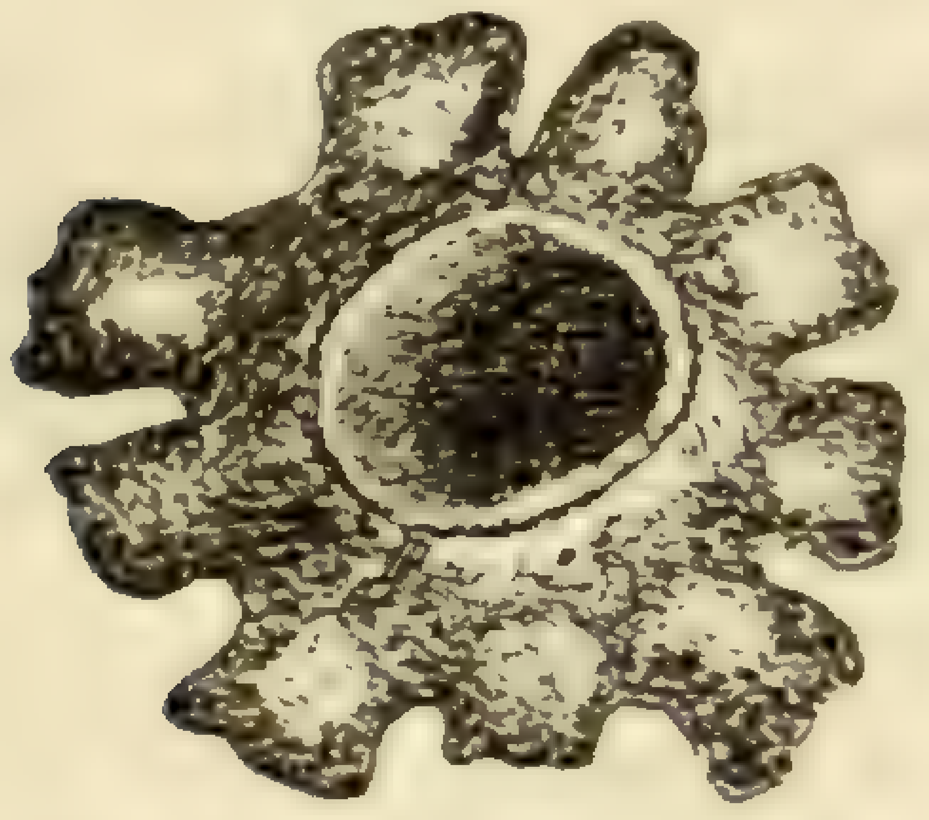

FIG. 5. *Brachiospongia;* reduced. (After Marsh).

One of the species of this family, known as *Cyathophycus*, occurs in clusters in the Utica slate rocks of New York. It is almost the earliest representative of a group that, in Devonian time, assumed a great development, and appeared in many different forms. The family is known as *Dictyospongidæ*, and presents an interesting instance of the beginning, the culmination and the dying out of a family of organisms. Beginning with the simple sac-shaped *Cyathophycus* (Fig. 6), or the globular *Rhombodictyon* in the Utica slate, it branched off into prismatic, nodulose (Fig. 7) or spinose *Dictyophytons* in the

Devonian, and died out in large, simple or rugose species in the lower Carboniferous age.

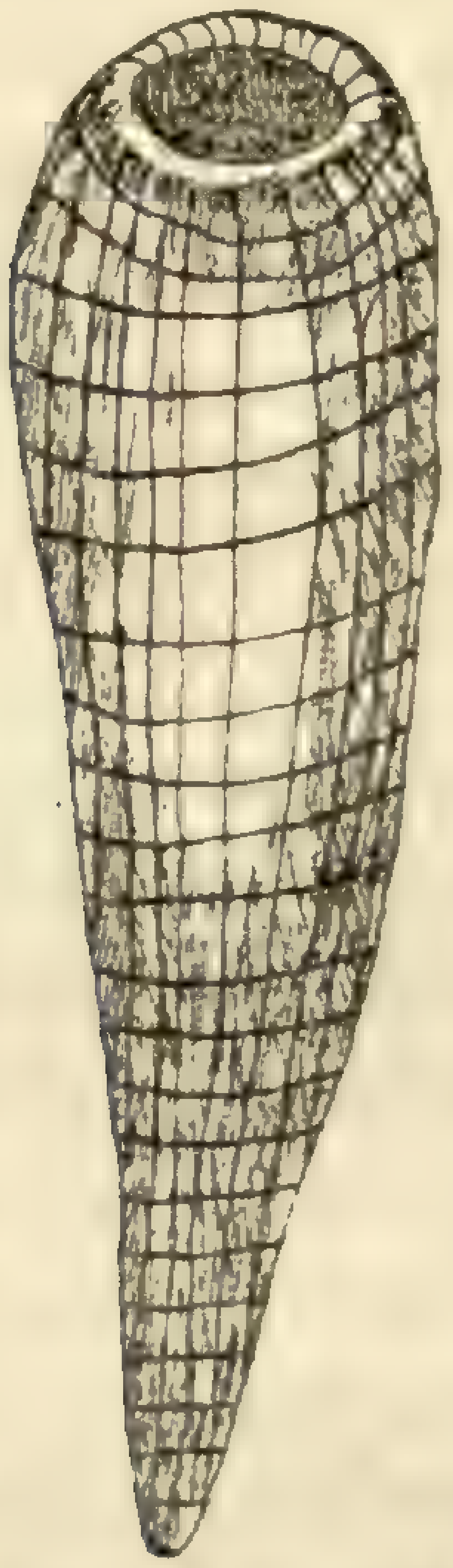

FIG. 6. *Cyathophycus.* (After Hall.)

FIG. 7. *Dictyophyton.* (After Hall)

A variety of sponges occur in deposits of Niagara age in various parts of the world. Among these are some peculiar globular and basin-shaped forms that have been found in deposits in Tennessee, in Ohio and in Gotland. They are known as *Astylospongia,* and were free-growing and unattached. The spiculæ are star-shaped and united by their extremities into a compact whole.

One of the most interesting modern discoveries relating to fossil sponges is that showing the flint nodules so common in all deposits of Cretaceous age, to be formed largely of sponge spicules. Not only is this so, but extensive deposits of chert of Permian and Carboniferous age, have likewise been shown to be made up largely of these bodies. A remarkable paper by Dr. G. J. Hinde, describes the contents of a hollow flint, about a foot in diameter, from near Norwich, England. He gives details of finding, in about three or four ounces of dried "flint meal" from this flint, many hundreds of sponge spicules, together with remains of other organisms. Some of the

objects were so completely changed to silica, that acid had no effect upon them; while others were so entirely composed of carbonate of lime as to be dissolved. Dr. Hinde describes and figures the spicules, and says that no less than one hundred and sixty forms were observed. These he classified into thirty-eight species of thirty-two genera. Some doubt may be expressed as to the validity of these genera and species, but that the spicules occur at all is sufficient evidence of the part the sponges played in the great formations, and indicates their abundance at certain periods in the past.

Modern deep-sea dredgings have shown that sponges exist now in wonderful profusion. In the Indian Ocean, out of about a quart measure of material, no less than sixty-two species of sponges were described. Dr. Hinde in discussing the relations between the habitats of modern and fossil sponges, notes the different depths at which various Atlantic species occur. Some of these are nearly related by their spicules to forms occurring in the flint nodule; and the conclusion is reached that the species there represented could have lived in water varying from 1 to 1700 feet deep. The resemblance between the spicules found in Dr. Hinde's flint, and those occurring in nodules in Ireland, Westphalia and Belgium; and in strata varying from Cretaceous to Eocene Tertiary, indicate an extensive distribution both in space and in time.

The importance of the statement of Sollas that spicules are being continually given off by the sponge in its process of growth is seen when it becomes known that thick beds of sediment are largely formed of these bodies. It at once reduces the number of individuals which it is necessary to imagine, if these strata are formed of the effete products, rather than of the remains of individual sponges.

Two interesting facts may be noted in conclusion, relative to this group of organisms. One is the great variability it presents. Professor Alexander Agassiz says (Three Cruises of the Blake, vol. 2, p. 170) that with the group all our ideas of species are completely upset. "It seems as if in the sponges we had a mass in which the different parts might be considered as organs capable in themselves of a certain amount of

independence, yet subject to a general subordination, so that, according to Haeckel and Schmidt, we are dealing neither with individuals nor colonies in the ordinary sense of the words." He then quotes Schmidt as saying that "in place of an individual, or a colony, we find an organic mass, differentiated into organs, while the body, which feeds itself and propagates, is neither an individual nor a colony." It would thus appear that the long existence of the group has not tended to the fixation of characters, and it is probable that the tendency to variation now manifest, was just as marked in early geological time.

The other point is of interest to evolutionists. Sollas points out that the same type of canal system exists in genera of three distinct and apparently unrelated families. Further, that the development of a cortex has taken place independently, though on parallel lines, in several other distinct families. Finally, that while calcareous and siliceous spicules have had an independent origin, yet the forms of the one are repeated by the forms of the other. He comes to the conclusion that variation does not depend upon accident, "but on the operation of physical laws as mechanical in their action here as in the mineral world." If, further, he continues, "the independent evolution of similar structures is of such certain and quite common occurrence in the case of the sponges, it is also to be looked for in other groups." Thus, a multiple origin of species, instead of being an improbability, is about as likely to occur as a single origin. Identically the same variety could scarcely arise in two isolated localities, but forms now supposed to be genetically related, may have been of distinct origin.

THE MOUTH-PARTS OF THE LEPIDOPTERA.

By Vernon L. Kellogg.

By the association of the genera Hepialus and Micropteryx as a group of forms sub-ordinally distinguished from all other lepidopterous forms, and characterized by a distinctly generalized condition of certain organs of the body, a special interest attaches to the study of the morphology of these genera. If the Jugatæ, as a sub-order of the Lepidoptera, is a more generalized group than the Frenatæ the morphology of its members is to be particularly studied for suggestions regarding the primitive form of the various organs of the lepidopterous insect, and, by summation, of the racial or ancestral type-form of the order.

The commonly unqualified statement of zoological and entomological text-books that the mouth-parts of the Lepidoptera are of a type adapted for sucking, and that mandibles are wanting, or rudimentary, should not be longer repeated without qualification. It has been known since the publication of Dr. Walter's study of the mouth-parts of[1] Micropteryx that the genus presents conditions of mouth-parts obviously contradicting the common assertion, and undoubtedly the most generalized known among the Lepidoptera. The presence of functional, denticulate mandibles, combined with the absence of a maxillar proboscis, make the general statement that the Lepidoptera are characterized by the possession of sucking mouth-parts an untrue one unless suitably qualified. And although this qualification will depend upon the presence of functional mandibles in but a few species of moths belonging to a single genus, the noting of these few exceptional instances is, obviously, of extreme importance. Dr. Walter found functional, denticulate mandibles in *Micropteryx aruncella* and *M. anderschella*. Associated with the presence of the functional

[1] Walter, A., in the Jenaisch. Zeitsch. f. Naturwiss., v. 18 (1885), pp. 751–807, 2 plates.

mandibles, these two species present a manifestly generalized condition of the other mouth-parts. The maxillæ possess two terminal lobes (galea and lacinia of orthopterous and biting insects generally), the outer ones, according to Dr. Walter, forming together the most primitive rudiments of a proboscis, while the inner ones form on each side a groove-like horny plate, which affords a lateral support for the labium. The lepidopterous proboscis is to be regarded therefore, according to Dr. Walter, as derived from the outer lobes (galeæ) of the maxillæ. In the higher forms the inner lobes (laciniæ) are reduced. The labium (second maxillæ) has free outer lobes, and a ligula formed by the fusion of the inner lobes into a short tubule which is open externally. Dr. Walter detected a short hypopharynx on the soft inner or hinder wall of the ligula. In *M. purpurella* and *semipurpurella* Walter found the mandibles to be without denticulations, and the maxillæ to have lost their inner lobes, the outer lobes being applied to form a typical sucking proboscis, the short organ being capable of being rolled up. The labium in these species is elongated, has no free outer lobes, and a small hypo-pharynx is discernible.

In the brief study which I have been able to make of the mouth-parts of *Micropteryx* the general conditions pointed out by Walter are apparent to me. I have examined the mouth parts of *anderschella, unimacullela, sparmanella,* and *purpurella.* In one important point, however, the few observations I have made lead me to differ from Walter in his derivation of the proboscis. It seems to me that they are the inner lobes of the maxilla (laciniæ) which go to produce the proboscis, while the outer lobes appear as short, hood-shaped processes with chitinized, firm margins, lying laterad of the base of the lacinia, and appearing as protecting or supporting processes for the inner lobes. This condition is well presented by *unimaculella.* In the maxilla (see fig. 6, plate XXV) of this species we make out a sub-circular cardo (*c*) a quadrangular stipes (st) from which arise the long, 6–segmented palpus (mx. p. x), the short, horny-margined protecting galea (mx. 1, e.), and as innermost process the long lacinia (mx. 1, i.), not fused with its mate

of the opposite side but capable of being applied to it so as to form a short proboscis. The mandibles (see fig. 5, *md*, plate XXV), of *unimaculella* are not denticulate, but single-pointed, and are not strongly chitinized, functioning rather as flexible lobes or plates than as biting jaws. The labium (see fig. 4, plate XXV), is truly lip-like, with plainly distinguished sub-mentum (*sm*), mentum (*m*), and prominent 3-segmented palpi (1, p.) rising from the outer or distal margin of the mentum. *M. purpurella* (see fig. 3, plate XXV), presents a condition of mouth-parts very like *unimaculella*. In *anderschella*, also, one of the species examined by Walter, the outer lobes again of the maxillæ are the ones which seem to me to be free, while the inner ones go to form the very rudimentary proboscis referred to by Walter. However, without study of other species the question may be left a moot one. For the object of this paper the exposition already made of the generalized state of the mouth-parts in *Micropteryx* is sufficient.

The condition of the mouth-parts of *Hepialus*, the genus associated with *Micropteryx* in the generalized sub-order *Jugatæ*, reveals an interesting further confirmation of the naturalness of the association. I have examined the mouth-parts of the *Hepialus hecta*, *sylvinus*, and of an undetermind species. Unfortunately, in this genus we have an atrophied or reduced condition of the parts, a functionless state, as so often met among Lepidoptera (*Bombyx et al*). This condition makes a comparison of the mouth-parts of *Hepialus* with those of *Micropteryx*, or of other Lepidoptera, difficult, but there are sufficient remaining evidences of the generally *Micropteryx*-like character of the mouth-parts to justify fully a recognition of their generalized character. Especially is this shown by the labium. In *Hepialus* sp. (fig. 10, plate XXV), the mandibles are entirely reduced, the maxillary palpi (*mx. p.*), greatly reduced, and one of the maxillary lobes lost, although one (*mx. 1.*), remains in reduced state. The labium, however, retains its lip-like character, with quadrangular mentum and thick, fleshy, 2-segmented palpi (*1. p.*), very like the similar organ in *Micropteryx* and altogether unlike the fixed sclerite forming part of the floor of the head, the character assumed by the altered labium of the higher Frenatæ (see fig. 9, plate XXV).

PLATE XXV.

Kellogg on Lepidoptera.

In *Hepialus sylvinus* (see fig. 1), the labium is fleshy and lip-like, as in the undetermined species, but the palpi, short and thick, are but 1-segmented, and all that is left of the maxilla is a short ex-articulate tubercle. In *H. hecta*, the broad thick mentum bears no palpi at all, and a faint suture separates the terminal, fleshy mentum from the narrow, fixed sub-mentum. The maxillæ are represented in *sylvinus* each by a short cylindrical tubercle. Thus, despite the obscurity which obtains in the condition of the mouth-parts of *Hepialus* because of their atrophied state, it seems apparent that they are reduced from a type with free lip-like labium, and with one or more free maxillary lobes, a generalized condition only met with elsewhere among the Lepidoptera in the genus *Micropteryx*.

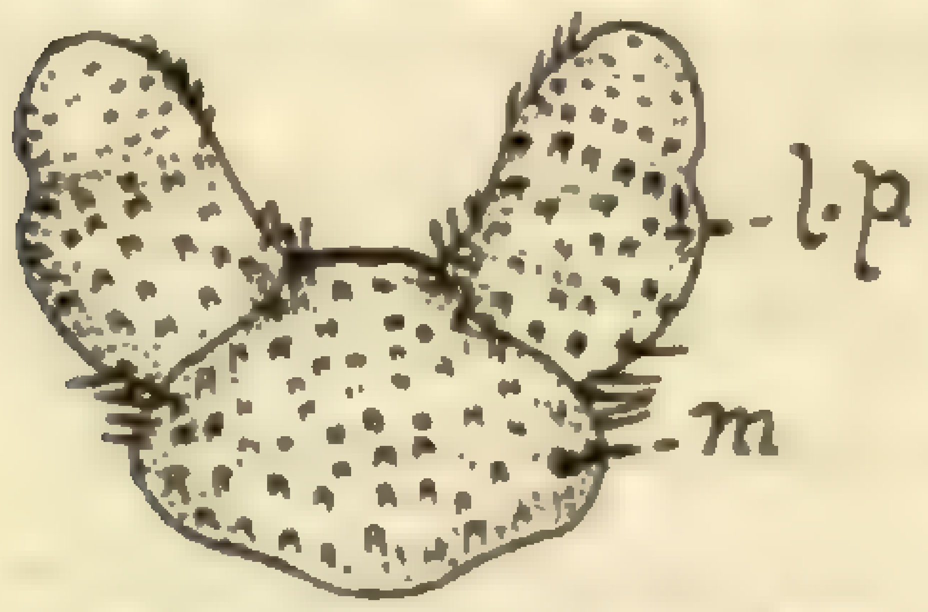

Fig. 1. Labium of *Hepialus sylvinus*; *m*, mentum; *l. p.* labial palpus.

Before proceeding to a brief consideration of certain structural features of the more specialized lepidopterous mouth-parts as presented in the Frenatæ, I wish to call attention to a few points of interest adduced from a comparison of the mouth-parts of the Jugatæ with those of the Trichoptera. Here, as elsewhere in the morphology of the Jugate and Trichopterous types,[2] the comparisons are suggestive. The morphology of the Trichopterous mouth-parts is an interesting, and by no means completed, study. Latreille and Pictet found no indications of mandibles; Kolenati and Westwood found rudimentary mandibles present. Some authors have thought the maxillæ and labium to be distinct, while Speyer and Kolbe declare them to be fused to form a sort of lapping or pseudo-sucking proboscis. Lucas[3] in his recent careful study of the mouth-parts of *Anabolia furcata* pretty conclusively demonstrates, for this species, at least, the entire absence of mandibles and the distinctness of maxillæ and labium (see fig. 1, plate XXV). In the few Trichopterous forms which I have ex-

[2] Author. The classification of Lepidoptera, in Amer. Nat, V. (Mar., 1895) pp. 248, 1 plate.

[3] Lucas, Robert, Beiträge zur Kenntnis der Mundwerkzauge der Trichoptera, Berlin, 1893. (Dissertation.)

amined, the variation in mouth-part characters is considerable. In all, the characteristic large labrum (see figs. 1 and 2, *lb.*, plate XXV), overlying the basal part, at least, of the haustellum (*h*) was present. The rudiments of mandibles were observed in but one species, *Hallesus* sp. The maxillæ present either rudiments of a free lobe, as in *Mystacides punctatus* (see fig. 2, *mx.* 1, plate XXV), or the lobe in a well-developed, sense-hair covered, probably functional condition, as in *Hallesus* sp, *Setodes* sp, *Hydropsyche scalaris*, and others. The basal part of the maxilla is sometimes pretty plainly divisible into cardo and stipes, as in *Hydropsyche scalaris;* more often, however, not. The labium usually presents a conspicuous, characteristic, expanded, and longitudinally striated flap, the haustellum (see fig. 1 and 2, *h.*, plate XXV), composed by the fusion of the terminal labial lobes. In *Hydropsyche scalaris* I was interested to discover the labium not so modified. The outer lobes were free and of rather large size; the inner lobes were represented by a pair of short, blunt tubercles, free from any indication of fusion with each other or with the outer lobes, the rudiments of free lobes.

In general the mouth-parts of the Trichoptera, where functional, may be held to exhibit the following characteristics; the absence of mandibles (or, at best, the presence of rudimentary functionless ones), maxillæ with basal portion often displaying distinguishable cardo and stipes, with functional lobes or distinct rudiments of both or of one free lobe, prominent several-segmented maxillary palpi, labium with its lobes free or coalesced to form the characteristic haustellum or lapping organ, labial palpi 3-segmented, prominent, (see figs. 1 and 2, plate XXV). Conspicuous and characteristic also is the large, flap-like labrum, which overlies the base of the haustellum, and aids materially in the half-lapping, half-sucking mode of taking food, which Lucas attributes to the Trichoptera. This conspicuous labrum is strikingly paralleled by the exceptionally large and well-developed labrum of *Micropteryx*, a feature not referred to in the previous discussion of the mouth-parts of this genus. In all the species of *Micropteryx* examined by me the labrum is large, appearing as a prominent triangular

flap, composed of a firmer basal region and a more delicate, membranous, distal region, the whole organ bearing many tactile hairs. It overlies the mouth-parts, extending beyond the mandibles and out over the fleshy labium (see figs. 3 and 5, *lb.*, plate XXV). This condition of the labrum is radically different from that presented by this organ among the Frenatæ, the more specialized Lepidoptera (see *postea*).

The long 5- to 6-segmented maxillary palpi of *Micropteryx* already pointed out in[4] Walter's admirable study of the maxillary palpi in the Lepidoptera as an indication of the generalized character of the mouth-parts of this genus, are very like, in point of number of segments and general habitus, the maxillary palpi of the Trichoptera. The maxillæ and labium in general characters are also similar in the two groups. The matter of mandibles is of special interest. In certain species of *Micropteryx* they are present as functional organs, although the tendency toward their reduction is fully displayed within the limits of the genus; in Trichoptera functional mandibles have not yet been found, although the distinct rudiments of mandibles are present. Manifestly now, as the tendency of specialization in both groups is toward a reduction to complete atrophy of the mandibles, the Jugatæ can not be looked upon as in any way lineal descendents of the Trichoptera. The affinity of the two groups must be of the character of two dichotomously divided lines of descent, diverging from a racial type which possessed conditions of mouth-parts, wing-venation, wing-clothing, and thoracic structure of a character suggested by the present conditions of these organs presented by the generalized members of the two groups.

The question of the presence or absence of rudimentary mandibles among the Trichoptera has been a bone of contention for insect morphologists, though it seems pretty obvious that if a sufficient number of species be examined both conditions

[4] Walter A., Palpus maxillaris Lepidopterorum, in Jen. Zeitsch. f. Naturwiss. v. 18, 1884. In this study Walter found that the maxillary palpi appear in a general series of lepidopterous forms from lowest moths to highest butterflies in a progressive state of reduction, 6-segmented in *Micropteryx*, entirely reduced among the Nymphalidae.

will be found. Lucas[5] devotes much space to his proof that certain small, angulated processes projecting from below the eyes, and called rudimentary mandibles by some writers, are not such, but the remnants of the lower one of a pair of tubercles which, in the pupa, marked the limits of the genal surface with which the prominent mandibles of the pupa articulated. The presence of these characteristic genal tubercles in all the species of *Micropteryx* which I have examined is worth mention (see figs. 3 and 5, *g. t.*, plate XXV). That these tubercles are not mandibular remnants (if, indeed, it is to these processes to which Savigny, Brauer, *et al.* refer) is well shown by *Micropteryx*, in which both these genal tubercles and the true mandibles or mandibular remnants are present and obviously distinct.

Passing now to the more familiarly known specialized Lepidopterous mouth-parts, a few commonly accepted beliefs demand brief reference. Moths and butterflies have been accredited with the possession of rudimentary mandibles as a general feature of the mouth-part conditions. The familiar statements and figures in entomological and zoological texts refer to certain slight projections lying on either side of the so-called labrum, a minute median triangular sclerite, as rudimentary mandibles. The statements and occasionally the figures are traceable back to[6] Savigny's enlightening study and explanation of the homologies of the insectean parts. This explanation was adopted by[7] Burgess in his description of the anatomy of *Danais archippus.* In a[8] study of the sclerites of the head of this butterfly. I became convinced that the so-called rudimentary mandibles of *Danais* are not such, but are projections from the lateral extremities of the labrum, which also, to my mind, is a larger and other sclerite than the minute triangular

[5] Lucas (*op. cit.*)

[6] Savigny, Jule-Cesar, Theorie des organes de la bouche des Crustacés et des Insects, *Insecta*, Linn., mem. 1–2, fasc. 1, partie 1, of the Memoires sur les Animaux sans Vertebres, 1816, Paris.

[7] Burgess. Edw., Contributions to the Anatomy of the Moth-weed Butterfly, *Danais archippus* Fab., 1880, Boston.

[8] Author. The Sclerites of the Head of *Danais archippus* Fab., pp. 51–57, with 1 plate in the Kas. Univ. Quart. v. 2, no. 2. Oct., 1893.

sclerite lying upon the base of the maxillar proboscis and called by Savigny, and commonly, the labrum (see *a. b. c.* of fig. 2). This minute triangular sclerite is a portion merely of the labrum, or may be indeed a true epipharynx, (i. e. process of the upper wall of the pharynx) fused, or apparently so, with the true labrum. In figure 13 of plate XXV, the cephalic aspect of the head of *archippus*, the labrum (*lb*), and its lateral projections, (*pf*), bearing on the inner margin a fringe of short, stiff, light-brown hairs, are shown. These labral processes I have called pilifers from the characteristic fringe of hairs which is always present. Rudimentary mandibles are to be found among the Lepidoptera but so far as I have observed not among the[9] Rhopalocera. When present, they uniformly arise from (i. e. are fused with) the genæ, as the mandibles normally are among insects possessing biting mouth-parts. A clear demonstration of the distinctness of pilifers and mandibles is afforded by the fact that both mandibles and pilifers are present in all cases where mandibles are found. This is well shown in the figure of the cephalic aspect of the head of *Protoparce carolina*, (fig. 12, *md.*, *pf.*, plate XXV).

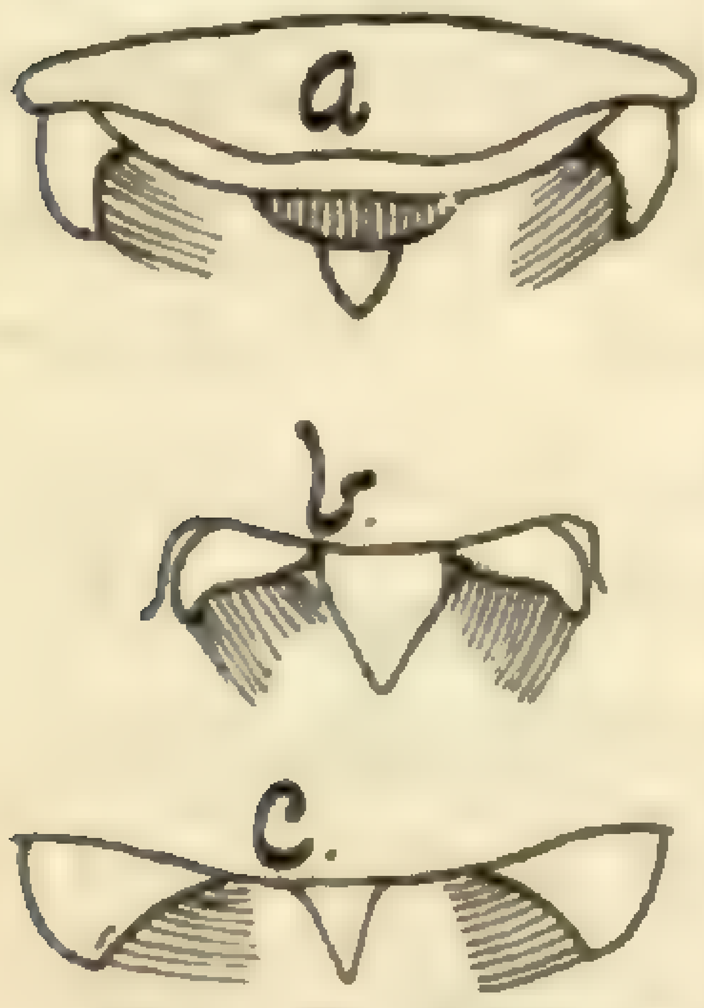

Fig. 2. The so-called labrum and mandibles according to Savigny; *a, Pieris daplidice* Lat.; *b, Nymphalis cardui* Lat.; *c, Zygæna scabiosæ* Fabr. (After Savigny.)

Here the conspicuous[10] mandibular rudiments, strongly chitinized at the denticulate apex, plainly arose from the genæ, and a faint articulating suture is visible. The pilifers are large, and manifestly continuous with the labral sclerite. I figure, also, the mouth-parts of *Hadena auranticolor* of same

[9] After having arrived at and published my conclusions regarding the error of designating as rudimentary mandibles the labial processes of *Danais* and the other butterflies (of all the Frenatæ, in fact), I found that Walter had previously come to the same conclusions, declaring that the parts designated by Savigny as mandibles are not such but processes of the labrum, and that the labrum of Savigny is to be regarded as an epipharynx.

[10] Despite Walter's assertion of his belief that no mandibles, even rudimentary, are to be found among the macro-lepidoptera, I cannot understand how else than as mandibular remnants these conspicuous processes articulating with the gena, chitinized and even slightly denticulate at tip, of the sphinx moths are to be interpreted.

family, Noctuidæ, as *Strigina poæ,* by which name Savigny refers to his figure of the lepidopterous mouth-parts most widely copied by subsequent authors of zoological text-books. In the figure of *Hadena* may be noted the pilifers, (see fig. 11, *pf.* plate XXV), but no indication of mandibular rudiments. In Savigny's reference to the lepidopterous mandibles he says that they are in all cases fringed very thickly with hairs on their inner margin ("++dans tous bordées de cils très-épais sur leur tranchant interieur"), (see *a, b, c,* fig. 1). He is evidently describing the pilifers which present just this condition. Newport in his article "Insecta" in Todd's Cyclopedia of Anatomy and Physiology (1836–39), discussing the mouth-parts of *Sphinx ligustri* says: "On each side of labrum are the rudiments of the mandibles. They are two minute triangular plates attached in part to the labrum and margin of the clypeus to which, as Savigny has remarked, they appear to be soldered. They are applied to the base of the maxilla, and in *Sphinx* appear each to be formed of two parts, and are covered along their margin with hairs." As already noted, it is among the sphinges that we find conspicuous rudimentary mandibles and pilifers present, with distinct insertions and with the characteristic features of the sclerites. It is the outer one of Newport's "two parts" which is the mandibular remnant, and the inner hair-bearing one which is the labral pilifer (see fig. 12, *md.* and *pf.*, plate XXV).

This erroneous impression regarding the identity of the lepidopterous mandibles receives, as already noted, common acceptance through the representations in the standard text-books. Figure 530, p. 556, in Claus's Lehrbuch der Zoologie (5th ed., 1891) is after Savigny's original figure of the mouth parts of the Noctuid, *Strigina poæ.* The sclerites lettered *md.* and called mandibles are the pilifers. In figure 104, p. 153, in Graber's Die Insekten (1877) the sclerites lettered *k*, and designated as mandibles, are the pilifers. In Packard's Guide to the Study of Insects, on page 232, in Hyatt and Arm's Insecta, plate IX, and elsewhere, the so-called mandibles are the pilifers. In Lang's text-book of Comparative Anatomy, p. 448, fig. 307, the pilifers are figured as parts of the labrum; the figure probably is after Walter.

Finally, I may call attention to another evident case of mistaken identity in Burgess's paper on the anatomy of *Danais*, not for the sake of picking flaws in this admirable one of the few American contributions to the knowledge of insect morphology, but for the sake of, if possible, preventing the confusion of the student of comparative insect morphology by his too willing complete acceptance of this monograph as a basis for his study of lepidopterous anatomy. Two minute, thorn-like projections, one on each lateral margin of the maxillar proboscis near the base, are referred to by Burgess as the rudiments of the maxillary palpi. Now the lepidopterous proboscis is composed of the greatly elongated terminal lobes (galeæ or laciniæ) of the maxilla, while the maxillary palpi always arise from the median or sub-basal sclerite, the stipes of the typical maxilla (in reality often from a more or less distinct sclerite, the palpiger, at the side of and closely applied to the stipes). We should expect, therefore, to find any palpal remnants on the fixed basal portion of the greatly modified lepidopterous maxilla, that portion which does not enter into the composition of the proboscis, but constitutes a portion of the fixed floor of the head (see fig. 9, *mx.* b., plate XXV). Where-ever the maxillary palpi or their rudiments are present among the Lepidoptera, and it is only among the highest, the most specialized, of the butterflies, that they can not be made out with certainty, these palpi or their rudiments do, in reality, arise from that very part on which our knowledge of the homologies of the insectean mouth-parts would lead us to expect to find them. This is well shown in the figure of the under side of the head of *Catocala* sp. (see fig. 9, *mx. p.*, plate XXV). Here the short, single-segmented, scale-covered palpal rudiments appear on the fixed basal part of the maxillæ, on the under side of the head, and at some little distance from the origin of the elongated, proboscis-forming, terminal lobes of the maxillæ.

Explanation of Plate XXV.

Fig. 1. *Anabolia fulcata*, cephalic aspect of head: *g. t.* genal tubercle; *mx. l.*, maxillary lobe; *mx. p.* maxillary pal-

pus; *h*, haustellum; *l. p.*, labial palpus; *lb*, labrum, removed and more enlarged. (After Lucas).

Fig. 2. *Mystacides punctatus*: *g*, gena; *g. t.*, genal tubercle; *mx. l.*, remnant of maxillary lobe; *mx. p.* basal segments of maxillary palpus; *lb*, labrum; *h*, haustellum; *l. p.*, labial palpus.

Fig. 3. *Micropteryx purpurella*: *a. f.*, antennary fossa; *md*, mandible; *lb.*, labrum; *g. t.*, genal tubercle; *mx. p.*, basal segments of maxillary palpus; *mx. l. i.*, elongated inner lobe of maxilla; *l. p.*, labial palpus.

Fig. 4. *Micropteryx unimaculella*, labium: *s-m.*, sub-mentum; *m.*, mentum; *l. p.*, labial palpus.

Fig. 5. *Micropteryx unimaculella*, cephalic margin of head, showing labrum (*lb*), mandibles (*md*), and genal tubercles (*g. t.*).

Fig. 6. *Micropteryx unimaculella*, ventral aspect of right maxilla; *c*, cardo; *st*, stipes; *mx. p.* basal segment of maxillary palpus; *mt. l. e.*, outer lobe; *mx. l. i.*, inner lobe.

Fig. 8. Catocala sp: *cl*, clypeus *g*, gena; *pf.*, pilifer; *mx. p.* maxillary palpus.

Fig. 9. Catocala sp., mesal portion of ventral aspect of head: *gu.*, gula; *lm.*, labium; *l. p.* labial palpus; *ge*, gena; *mx. b.*, fixed basal portion of maxilla; *mx. p.*, maxillary palpus.

Fig. 10. Hepialus sp., ventral aspect of head: *lm.*, labium; *m.* mentum; *l. p.*, labial palpus; *mx. l.*, remnant of maxillary lobe; *mx. p.*, remnant of maxillary palpus.

Fig. 11. *Hadena auranticolor*: *g.*, gena; *pf.*, pilifer; *mx. p.* maxillary palpus; *mx. l.*, maxillar proboscis formed of elongated maxillary lobes.

Fig. 12. *Protoparce carolina*; *ep.*, epicranium; *cl*, clypeus; *lb.*, labrum; *ge.*, gena; *md.*, remnant of mandibles; *pf.*, pilifer.

Fig. 13. *Danais archippus*: *g.*, gena; *lb.*, labrum; *pf.*, pilifer.

RECENT LITERATURE.

The Cambridge Natural History.[1]—This series, to be completed in 10 volumes, under the general editorship of Messrs. Clark, Harmer and Shipley, was announced some time ago, and this, the third of the series, is the first to be issued. Next to appear will probably be the insects (2 volumes) and the birds. Of the present volume 459 pages are occupied by the molluscs, and in their treatment we find much to enjoy. Most of the chapters read easily and interestingly, and the author has, apparently, thoroughly assimilated much of the recent literature relating to the life histories and habits, especially of the terrestrial forms. This side occupies the first hundred and twenty pages, and is then followed by a slight and thoroughly readable sketch of the morphology. The next section treats of the geographical distribution, and the concluding chapters are occupied with the classification in which the divisions down to families are characterized, and the principal genera enumerated merely by name.

Did space permit, we would gladly give many extracts of interesting items from the pages, for even the hints as to phylogenetic lines are treated with a freshness which demands praise—but we must forbear. We can only refer (p. 119) to the use of snails in the manufacture of artificial cream, to the chapter on pearls, and the exceedingly clear presentation of the modifications of the odontophoral teeth. Yet we note, here and there, a lapse. Thus, in the boring, by means of the odontophore (p. 237), the observations of Schiemenz are not mentioned. In the matter of the eyes of Chiton, Blumrich's results are overlooked, while through the work so thoroughly have the American printers followed the English copy that Connecticut's metropolis appears throughout as "Newhaven." The classification adopted is, in its main features, that of Pelseneer for the Gasteropods and Acephals (excepting in the matter of the Chitons and Neomenidæ), while the Cephalopods are according to Hoyle.

In their treatment of the Brachiopods, Messrs Shipley and Reed have had less of popular interest to deal with, but the accounts are clear and this portion of the work will doubtless prove of no little assistance to young paleontologists.

[1] The Cambridge Natural History, Vol. III. Mollusca, by A. H. Cooke; Brachipods (Recent), by A. E. Shipley; Brachipods (Fossil), by F. C. Reed. New York and London: Macmillan & Co., 1895; 8vo. pp. xix 535.

Regarding the affinities of Brachiopods, Shipley says, after mentioning their former association with Molluscs, Tunicates, Polyzoa, etc.: "As far as I am able to judge, their affinities seem, perhaps, to be more closely with the Gephyrea and with Phoronis than with any of the other claimants; but I think even these are too remote to justify any system of classification which would bring them together under a common name."

Judging by this single volume, the series promises well. It is well illustrated by new figures; its language is clear and simple, and seems well adapted for those who, while not professional naturalists, wish to know something more than they get from their college course, as well as for those who, deprived of suitable instructors, wish to go farther into zoological subjects than they can without aid.

Marshall's Biological Lectures and Addresses.[2]—A series of thirteen lectures, delivered by the late Arthur Milnes Marshall, between the years 1879 and 1890, has been published in book form under the supervision of C. F. Marshall. Among them are four Presidential addresses to the Manchester Microscopical Society and the discussion of the Recapitulation Theory which formed the subject of an address before the Biological Section of the British Association of Leeds in 1890. The articles are written in a clear and direct style, and are admirably adapted to instruct the general reader. We can recommend the book as introducing the principal problems of modern biology to the reader in an agreeable and comprehensible manner.

Butterfly Hunters in the Carribees.[3]—A pleasing little book, purporting to be the adventures of two boy naturalists, with their tutor, in the West Indies. The author carries the party safely through a number of adventures ingeniously contrived to bring out some scientific or historical fact. A good deal of information is imparted in an agreeable way, in some cases, however, not entirely reliable in its statements regarding matters not falling within the domain of lepidopterology. Thus, on p. 54, it is stated that a snapping-tortoise was found by the explorers! and, on p. 60, that they examined a snake allied to the pine snake of N. America, which squeezed the arm of its captor. In another place, the author lets the reader infer that blood-sucking

[2] Biological Lectures and Addresses. By Arthur M. Marshall. Edited by C. F. Marshall. London, 1894: Macmillan & Co., Publishers.

[3] Butterfly Hunters in the Carribees. By Dr. Eugene Murray-Aaron. New York, 1894. Charles Scribner's Sons, Publishers.

vampires occur in the West Indies. An interesting chapter is devoted to the habits of the rare *Papilio homerus* of Jamaica.

On the whole, the book will probably serve its purpose, viz., to stimulate young people to an active, wholesome interest in the field work of natural history.

L'Amateur de des Papillons.[4]—This handy volume is one of the series, *Bibliotheque des Connaissances utiles*, contributed by M. H. Coupin, and is intended for the use of amateur butterfly collectors. After a brief discussion of the organization and life-history of this order of insects, in the course of which is given a concise account of "mimicry," polymorphism and parthenogenesis, the author comes at once to the main idea of the work, namely, advice to the amateur collector. Descriptions of articles included in a good outfit for collecting and preserving material are followed by advice as to where and how to find different species, not only of the adult but of the chrysalid, caterpillar and egg. Finally, a chapter on mounting and displaying the collection completes this admirable book of instruction.

The book is profusely illustrated, a matter of considerable importance where the text is necessarily so concise.

Monographic Revision of the Pocket Gophers.[5]—This work is one of the North American Fauna Series, published by the U. S. Dept. of Agriculture. It has been prepared by Dr. Merriam after a critical study of over a thousand specimens, including many types, and constitutes a monograph of the family Geomyidae, exclusive of the genus Thomomys. The systematic descriptions of the genera and species are prefaced with a discussion of the morphology of the skull, and a description of some remarkable dental peculiarities as to the distribution of the enamel discovered by the author during his investigation. The opening chapter contains an interesting account of the habits and distribution of these animals, variation, both sexual and individual, and a key to the genera.

The book is well illustrated with 20 full-page plates, 71 text figures and 4 maps, 3 of which show the distribution of the different genera, and one gives the distribution of the species of Geomys and Cratogeomys.

[4] L'Amateur des Papillons. Guide pour la Chasse, la Preparation, et la Conservation. By M. Henri Coupin, Paris, 1895. B. Ballière et Fils, Editeurs.

[5] North American Fauna, No. 8. Monographic Revision of the Pocket Gophers, Family Geomyidae (Exclusive of the species of Thomomys). By Dr. C. Hart Merriam. Washington, 1895.

A *Geomys lutescens*, kept in confinement by Dr. Merriam, could run backward as rapidly and easily as forward. The well-known peculiarity of the external genitalia of the male, which are so hidden and modified that the sexes are determined with difficulty, is doubtless connected with this habit, the parts being protected from injury when the animal is moving backward. Another fact learned by Dr. Merriam from the captive Geomys is that the tail functions as an organ of touch. It is rather large and fleshy, and is apparently endowed with special tactile sensibility, and is evidently of great value in warning the animals of the presence of an enemy in the rear when they are traveling backward in their dark tunnels.

Dr. Merriam has divided these animals into several genera, but the characters regarded as definitive seem to be hardly sufficient for that purpose. They appear to us to be more properly sections of a single genus.

A Monograph of the Bats of North America.[6]—This work is one of a series of papers intended to illustrate the collections belonging to the United States National Museum. It is, in reality, a revision of a monograph published in 1864 by the same author, with such additions as have been necessitated by the study of new material. The old descriptions have been elaborated, the new standards of comparisons adopted, and many newly observed anatomical details included in the introduction.

The region covered by the monograph includes North America, extending to the southern limit of the United States.

Thirty-eight plates, of skillfully executed drawings, give the details of the external characters, of the osteology and of the dentition. The work is authoritative in this branch of N. American mammalogy, and the student of this subject will find it a *sine qua non*.

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General Notes.

MINERALOGY.[1]

Origin of the "Pflockstruktur" of Mellilite.—The "peg structure" ("Pflockstruktur," "Structure en chevilles") of mellilite is one of its most constant characteristics. This structure has been attributed to original glass inclusions in the mineral. Gentil[2] has recently made a careful microscopic study of this mineral from the localities of Mte. Vultura, Capo di Bove, Hohenstoffeln (Höhgau), Hochbohl, Palma (Canaries), and Rachgoun (Algiers). He concludes that the "peg structure" is due to products of decomposition of the mellilite, of which the most common is a honey-yellow hydrated substance which gelatinizes readily with hydrochloric acid. It has a lower index of refraction and a weaker double refraction than mellilite. The double refraction is so weak as to be hardly appreciable in the small thicknes of the "chevilles" and hence was supposed by Rosenbusch to be isotropic. In the mellilite of Vultura and Capo di Bove it is, however, easily made out. In the mellilites from Hochbohl and Palma the decomposition has proceeded farther, producing a zeolite, probably mesotype. This process Gentil likens to the serpentinization of olivine. The direction of development of the "chevilles" (normal to the base) is a direction of easy decomposition and is, in some cases, at least one of weak cohesion.

Blowpipe Coatings on Glass.—Goldschmidt[3] has proposed the use of a simple device for holding a small glass plate (an object or cover glass) or a mica lamella on the surface of a stick of charcoal, so that the blowpipe coatings are deposited on the glass or mica. It is thus possible to remove them and examine under the microscope or by chemical methods. The fusibility or solubility may be tested and the material is adapted to study by the methods of microchemical analysis. By use of sodium sulphide as a reagent, colored precipitates are obtained as follows: From arsenic, cadmium yellow; antimony, reddish-yellow; lead, molybdenum, tellurium, and copper chloride,

[1]Edited by Dr. Wm. H. Hobbs, University of Wisconsin, Madison, Wis.

[2] Bull. Soc. Franç. Minér., xvii, pp. 108–119. May, 1894.

[3] Zeitsch. f. Kryst. xxi, pp. 329–333, 1893.

black; zinc and tin, unaltered. The method is of special importance in distinguishing arsenic and antimony compounds, and in determining zinc, thallium, and telluric acid.

Use of Phosphorus in Studying Minerals of High Refractive Index.—Retgers[4] uses colorless to yellow phosphorous as a medium in which to imbed small mineral grains, which, because of their high refractive index would appear black if imbedded in Canada balsam. Melted phosphorous has a very high refractive index ($n_D = 2.075$) and if used in grains of the size of a pin head can be handled without danger. Such a grain is heated on an object glass till fusion begins and quickly compressed under the cover glass. The substance remains long fluid in the capillary space and consolidates clear and transparent. Rutile, brookite, and anatase are the only rock-making minerals of higher index than the phosphorous and these are brought out more clearly by it. If the mineral grains to be examined are so coarse that there is considerable danger of the oxidization of the phosphorous, the latter may be dissolved in carbon bisulphide. It is much more convenient to work with the solution but its maximum index is considerably lower than that of the fused metal.

Chalcocite from Monte Catini.—Boeris[5] has investigated some specimens of chalcocite from the Monte Catini mines, Lucca, Italy. On these crystals he has made out five forms new to the locality { (230), (012), (023), (021), (111) }, and one (052) which is new to the mineral. Another new form (270), though very small, was determined with considerable probability from its zones. There is also described a new twinning law for the species, the twinning plane being a face of (011).

Diopside and Apatite from Zöptau.—Gräber[6] describes this new locality for diopside and apatite. The former appears in crystals up to 5 cm. long, which have terminations conditioned by the forms *z* (021), *p* (101), *u* (111), and *s* ($\bar{1}11$). The crystals are bright grass green and translucent. The crystals of apatite are thick tabular and ½–1 cm. long, and are either colorless or of a pale amethyst color. They occur loose in clay and in a much weathered horneblende schist. In addition to the base, first order prism, and first and second order pyramids, two-third order pyramids, μ ($12\bar{3}1$) and u ($13\bar{4}1$) are found on the crystals.

[4] Neues Jahrb. f. Mineral., etc., 1893, II, pp. 130–134.

[5] Zeitsch. f. Kryst:, xxiii, pp. 235–239, 1894.

[6] Tscherm. Min. u. Pet. Mitth., xiv (1894) pp. 266–270.

Serpierite.—This mineral, which comes from the Laurium Mts. in Greece, was described by Bertrand and Des Cloiseaux[7] and Damour in 1881, but no analysis was made of it. Damour described it as an insoluble hydrated basic sulphate of zinc and copper. Frenzel[8] has recently analyzed the mineral and found it to contain eight per cent of lime and very minute quantities of aluminium, chlorine, and sodium. The analysis is as follows: CuO 36.12, ZnO 13.95, CaO 8.00, SO_3 24.29, H_2O 16.75, Total 99.11. This corresponds to the empirical formula 3 (CuO ZnO CaO) SO_3+3H_2O.

Lautite.—This mineral has been considered a mixture by Groth and Weisbach. A new find from the Rudolf Schachte at Lauta, near Marienberg, Sax., is according to Frenzel[9] very pure, though it never occurs in crystals or even in large masses. The following analysis by him he considers sufficient evidence that lautite is an independent mineral:

	Percentages.	Molecular ratios.
Cu	36.10	0.568
As	45.66	0.608
S	17.88	0.559
	99.64	

The content of silver in the mineral varies from 0–12 per cent, and perhaps more.

Study of Optical Anomalies by Artificially Coloring.—Senarmont and later Otto Lehman showed that anisotropic crystals may be artificially colored by adding coloring matter to the solution in which they are forming. They thus become pleochroic. Gaubert[10] utilizes this fact in examining some pseudo-isometric crystals—the anhydrous nitrates of barium, lead, and strontium. The colored crystals obtained show six pleochroic sectors at the same instant, the opposite sectors having the same tint. If a barium nitrate solution be divided into two parts and one of these be colored with methelene blue, the colored crystals obtained have intense pleochroism, although the uncolored crystals from the other part of the solution exhibit no double refraction.

[7] Bull. Soc. Minéral. de France, iv, p. 89, 1881.
[8] Min. u. petrog. Mitth., xiv, pp. 121–130, 1894.
[9] Ibidem.
[10] Bull. Soc. Franç. Minér., xvii, pp. 121–123, May, 1894.

New Method of Illuminating in Photomicrographic Work.—Köhler[11] has suggested a method of securing even illumination of the field when artificial light is used. Instead of removing the condenser and collector from the microscope, as is usually done, thus securing an image of the source of light in the plane of the section, Köhler makes use of an accessory lens and so adjusts the condenser that a sharp image of the accessory lens is brought to the plane of the section. The object is thus uniformly illuminated, even to the margin.

Chemical Behavior of Dimorphous Minerals.—Doelter[12] has studied the comparative action of reagents on some dimorphous minerals, viz.: andalusite and kyanite, orthoclase and microcline, epidote and zoisite, enstatite and anthophyllite, diopside and actinolite, pyrite and marcasite, and sphalerite and wurtzite. Finely powdered specimens of each were subjected under similar conditions to the action of such reagents as chlorine and hydrochloric acid gases, hydrofluoric acid, potassium and sodium hydroxides, etc., to determine their relative decomposability. Marcasite is found to be less decomposed by solution of soda than pyrite. The fact that on treatment with water or sulphide of soda, the mineral which separates from the solution on evaporation is always the particular modification which was dissolved, seems to show a chemical difference between the two dimorphous forms of ZnS and those of $Fe S_2$. In many other cases the results were negative or the differences were such as might be explained by the slight chemical differences of the substances taken.

Pearls.—Though perhaps not strictly to be included in the field covered by these reviews, it seems proper to call the attention of mineralogists to the admirable paper by the late Professor Karl Möbius on pearls[13], in Velhagen and Klasing's popular magazine. This scientific paper discusses not alone the methods of fishing and extracting pearls, but describes, with the aid of beautiful figures, the different fresh and salt water mussels which bear pearls, the structure of the animal, and the manner of growth of the pearl. The structures of the pearl itself are made clear by drawings from microscopic sections, prepared by the author from a number of valuable gem pearls. The connection between the structure and surface and the value of the gem is also discussed.—Wm. H. Hobbs.

[11] Zeitsch. f. Wiss. Mikroskopie, **10**, p. 443 (1893). Abstracted in Zeitsch. f. Instrumentenkunde, **14**, pp. 410–411 (1894).

[12] Neues Jahrb. f. Miner., etc., 1894 (II), pp. 265–277.

[13] Die echten Perlen. Velhagen und Klasing's Monatshefte, IXte Jahrgang, pp. 325–335. (Nov. 1894.)

PETROGRAPHY.[1]

The Eruptive Rocks of the Christiana Region.—Brögger[2] has done an excellent piece of work in this, the first of his reports on the eruptive rocks of Norway. The article deserves much more notice than can be given it in this place. Briefly, the author describes grorudite, salvsbergite and tinguite dykes which together form what is denominated a rock series—that is, a series of rocks that differ slightly from each other in their chemical composition, but which, at the same time, by their intimate gradations into each other, give evidence of being closely related. All of these rocks are rich in soda and potassa, and all contain alkaline amphiboloids. The grorudite is essentially an aggregate of microcline and albite, usually in microperthitic intergrowths, rarely anorthoclase, and always aegerine and amphibole, as phenocysts, in a groundmass of potash feldspar, albite, sometimes soda-orthoclase, aegerine and more or less quartz. The amphiboles are arfvedsonite and katoforite, the latter name being given to a series of alkaline iron amphiboles having the angle $C \wedge c = 31°–58°$, and pleochroism as follows: $B > C > A$ = yellowish red > brownish red > yellowish red or greenish yellow. In all their properties, so far as studied, they occupy a position between barkevikite and arfvedsonite. Salvsbergite differs from grorudite in containing little or no quartz. Its structure is trachytic.

Grorudite is regarded as the dyke form of soda-granite and pantellerite and salvsbergite that of nordmarkite.

After a discussion of the significance of the notion of dyke rocks as a group of well-defined rock types, the author concludes that while the group is well characterized by Rosenbusch, it includes a number of rocks that are but apophyses of bosses, etc., and which should be classed with the rocks of bosses. He prefers the term "hypabyssische Gesteine" for all rocks with the structure of dyke rocks, whether they be in the form of true dykes, of sheets, or whether they occur as the peripheral form of bosses or laccolites. The hypabyssmal rocks comprise a great group of equal value with that of the surface (volcanic) rocks and that of the abyssmal (plutonic) rocks. It includes two classes—the aschistic and the diaschistic—the first embracing those rocks not produced by the differentiation of their source-magma, and the latter

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Maine.

[2] Viedenskabsselskabels Skrifter. Math.-naturv. Klasse, 1894, No. 4.

those thus produced. The diaschistic rocks form complementary members, such as the minettes and aplites. The complementary form of salvsbergite is lindoite, a trachytic aggregate of phenocysts of microperthite and brown biotite, in a groundmass of quartz, biotite, aegerine and various secondary products, among which carbonates play an important *rôle.*

The laws of differentation in the different parts of the dykes are studied through the aid of a large number of carefully made analyses, as well as those governing the differentiation of the dyke masses from the boss masses. In all cases it is found that the differentiation consists in an increase in Fe_2O_3 toward the sides of the dyke, and an increase of the same constituents in the dyke masses as compared with the coroesponding boss material. The original magma is believed to have split into two magmas, one of which yielded the laccolite and boss material, and the other the substance of the diaschistic dykes. The former, in turn, split in the same way into a peripheral and a main phase, the former of which gave rise to the aschistic dykes.

The large number of analyses accompanying the discussion, and the careful description on which it is based, supply an excellent basis on which the long-desired genetic and philosophical classification of rocks may be founded, provided the lines of thought developed by the author are found to hold for other regions than those of southern Norway.

The Massive Rocks of Arran.—A very full account of the petrographical features of the massive rocks of the southern half of the Island of Arran has been given by Corstorphine[3]. The rock-types include pitchstones, quartz porphyries, normal diabase, quartzitic phases of the same rock, olivine-analcite varieties and sahlite diabases, all of which occur in sheets or dykes. The pitchstone presents no unusual characters. The quartz porphyries include those with a spherulitic groundmass and those whose groundmass is crystaline, and among the latter are micrographitic and micropegmantic varieties. The quartz-bearing diabases are usually in sheets. They contain large macroscopic quartzes and feldspars, especially near their contacts with the porphyry, and at their contacts with the underlying sandstone they contain large fragments of this rock. In the normal biabase both hypersthene and biotite occur. The large crystals of quartz and feldspar are regarded as foreign components, which have been caught up from the porphyry. The olivine analcite diabase is a typical diabase in which zeolites, and especially analcites, are abundant. These occupy the interstices be-

[3] Minn. u. Petrog. Mitth., XIV, p. 443.

tween the plagioclase and augites, and are thought to have originated from the alteration of nepheline.

Migration of Crystals from a Younger to an Older Rock.—It has long been assumed, that of two igneous rocks in contact, that containing crystals peculiar to the other was necessarily younger than the latter. Cole,[4] however, shows that crystals may be floated away into a pre-existing rock of a low degree of fusibility from one of a higher degree which has intruded it. At Glasdrumman Port, County Down, Ireland, a dyke of eurite is flanked on both sides by dykes of basaltic andesite, of which the andesites are unquestionably the older rocks, since the eurite on its contact with them encloses fragments torn from their sides. The eurite contains porphyritic crystals of pink orthoclase, while the andesite is normally devoid of them. Near its contact with the former rock, however, crystals exactly like those in the eurite are occasionally found in the andesite. Crystals of quartz and feldspar have also often been floated from the eurite into the detached fragments of the andesite. The invading rock has melted the groundmass of the andesite and has left its larger crystals scattered through a matrix made up largely of molten andesite intermingled with some eurite substance.

Notes.—In a report accompanying an excellent geological map of Essex Co., Mass., Sears[5] describes briefly the following rocks: Hornblende granitites, granophyric granitites with a flowage structure, augite-nepheline syenites, hornblende diorites, quartz-augite-diorites, muscovite-biotite-granites, norites, quartz porphyries, peridotites, gneisses, both igneous and clastic, bostonite and tinguaite dykes and various effusive rocks.

A series of chemical analyses of the gneissoid granites, granite porphyries and porphyrites of the Bachergebirge in Stiermark, has been made by Pontoni[6] in order to discover whether all the granite porphyries, that form great dyke masses in the region, have the same composition or not, and whether the small porphyrite dykes that cut the granite are like the granites and the granite porphyries or are unlike them. The conclusion reached is to the effect that the granite porphyries are identical with the gneissoid granites of the region, and that the porphyrites are independent intrusives.

[4] Scient. Trans. Roy. Dub. Soc., Vol. V, Ser. II, p. 239.
[5] Bull. Essex Inst., XXVI, 1894.
[6] Min. u. Petrog. Mitth., XIV, p. 360.

Zaleski[7] has made, with great care, a number of chemical analyses and mechanical separations of several granites to determine whether or not they are syenites plus quartz; that is, whether or not the chemical limits between which these rock types vary are fixed. His results may be tabulated as follows:

Locality.	SiO_2 Content.	SiO_2 of rock—Quartz.
Dannemora,	61.06	54.08
Nigg,	69.84	65.33
Hangö,	71.42	59.46
Baveno,	74.44	41.38

Of these granites only one possesses the silica content of syenite after the quartz has been abstracted from it.

Spurr,[8] in a bulletin on the iron-bearing rocks of the Mesabi Range in Minnesota, describes a series of fragmental and cherty rocks associated with the ores. One of these, to which he gives the name "taconite," consists of a groundmass of silica, in which are granites of a green substance, regarded by the author as glauconite. These are always more or less altered, yielding siderite, magnetite, hematite, etc. The sideritic phase of this taconite is like the original carbonate of Irving and Van Hise.

In a small collection of specimens from central and western Paraguay, Milch[9] has recognized quartzites, limestones and phonolites.

GEOLOGY AND PALEONTOLOGY.

Niagara and the Great Lakes.—Another contribution to the history of the Great Lakes is published by F. B. Taylor.[10] It is the eighth of a series and brings the history up to date. In an introduction the author refers to the recent papers of Professor J. W. Spencer and Mr. Warren Upham on the post-glacial history of the Great Lakes in the following language:—

"Prof. Spencer on the one hand levels all the higher abandoned beaches with the sea, and does not distinctly recognize a single ice-

[7] Ib., XIV, p. 342.

[8] Bull. No. X, Geol. and Nat. Hist. Survey of Minn.

[9] Min. u. Petrog. Mitth., XIV, p. 383.

[10] Amer. Journ. Sci. Arts, 1895.

dammed lake. Mr. Upham, on the other hand, ascribes nearly all submergence to ice-dammed lakes, and admits none as marine except that which is proved by fossils. As often happens in such cases, the probability is that the truth lies between these wide extremes. Ice dams have played an important part, but not to the exclusion of marine submergence even at high levels. On the other hand, marine invasion is not available as an explanation for some of the most important areas of submergence."

Mr. Taylor's views of the subject under discussion are summarized in the following chronological conspectus, taken from the last paper of his series, from which it will be seen that they are of the medium character referred to above:

"As its maximum the great Laurentide glacier covered the whole area of the Great Lakes. By a correlation of the abandoned shore lines, moraines and outlets, and the gorges, recently submerged shores and rivers of this region the following order of events is made out for the post-glacial history of the Great Lakes. They are set down in seven principal stages with transitions or critical stages between.

"1. Glacial, ice-dammed lakes. Outlets at Fort Wayne, Chicago and other places. Beaches correlated with moraines in Ohio. Glacial lakes fall by stages as outlets change on withdrawal of the glacier-dams. Land relatively high in the north but slowly subsiding.

"*First transition:* By withdrawal of glacier the Niagara river is opened and the upper lakes become united.

"II. First Niagara lakes. First epoch of Niagara Falls begins at Lewiston. For a short time glacial Lake Iroquois receives the water from Niagara. Shore lines of lower levels of this glacial lake washed over and obliterated by later marine invasion. Gradual depression of land continues at north, finally opening Nipissing outlet.

"*Second transition.*—First two-outlet climax. Marked by the Algonquin Beach. (Possible subdivision here for Trent river outlet). Gradual northward depression continues. First epoch of Niagara Falls closes at the Whirlpool. Epoch of Erigan Fall begins.

"III. First Lake Algonquin. Outlet eastward over Nipissing pass.

"*Third transition:* Gradual northward depression continues. Nipissing outlet brought down to sea level. Lakes become marine.

"IV. Warren Gulf (rising stage). Marine waters fill the three upper lakes, the Ontario, St. Lawrence, and Winnipeg basins.

"*Fourth transition:* Marine climax. Marked by the Chippewa Beach. Northward depression ceases and gradual elevation begins,

Iroquois and Herman marine beaches made at the same time as the Chippewa. This was probably the climax of the post-glacial warm epoch.

"V. Warren Gulf (falling stage). Gradual northward elevation. Irregular uplifts in the north deforming Chippewa and Algonquin beaches.

"*Fifth transition:* Nipissing outlet raised to sea level. Upper lakes become fresh.

"VI. Second Lake Algonquin. Outlet eastward over Nipissing pass. Probably a small amount of local uplift at outlet in early stage.

"*Sixth Transition:* Second two-outlet climax. Marked by the Nipissing Beach. Epoch of Erigan Fall closes at a point between 40 and 80 rods above the cantilever bridge. Second (present) epoch of Niagara Falls begins.

"VII. Second Niagara lakes (present stage). Lake Superior becomes independent. Great Champlain uplift at the northeast. Formation of St. Clair delta begins and continues to the present time." (Am. Journ. Sci., April, 1895.)

Fossil Insects.—M. Brogniart in a work on fossil insects recently published recognizes 62 genera of cockroaches represented by 137 species, many of which are new, and described for the first time by the author. Among other facts made known is the existence of carboniferous insects having three pairs of wings. Certain other species keep, in the adult form, a larval characteristic, being furnished with respiratory plates on the sides of the abdomen, comparable to those of the larvæ of modern Neuropters.

The modern cockroaches lay their eggs, generally, enclosed in an egg-bearing capsule; the Paleo-species, on the contrary, had an ovipositor and laid their eggs one by one as the grasshoppers do.

The Protolocustides and Paleacridides were jumping Orthopterons insects like the grasshoppers and katydids of the present time, but their posterior wings were as large as the anterior ones and were not folded like a fan. (Bull. Acad. Roy. des Sci. 1895.)

The Phylogeny of the Whalebone Whales.—At a meeting of the American Philosophical Society held May 3d, 1895 Prof. E. D. Cope gave an account of the types of Mystacoceti which had been discovered, and which throw considerable light on the probable phylogeny of the suborder. He pointed out that the *Zeuglodon pygmæus* of

PLATE XXVI.

Dinictis bombifrons, Adams, x ½.

Müller is in cranial characters much like Mystacoceti of the genus Cetotherium, and that it is probable that the latter were derived from the forms by the loss of their teeth. The structures of the mandibular rami of various species show the transitions from such a form to those of the right whales. Deriving the Balænidæ then from a form like that of the new genus Agorophius (type *Zeuglodon pygmæus* Müll.), we have a succession of genera in which the gingival groove and dental canal show various stages of roofing, fusion or obliteration. The genera of the Neocone beds were defined as follows.

I. Gingival groove distinct from dental canal.

Gingival groove open; *Genus not discovered.*

Gingival groove overoofed; *Siphonocetus* Cope.

II. Dental canal not distinct; gingival groove open.

Gingival tubules wanting; *Ulias* Cope.

Gingival tubules present; *Tretulias* Cope.

III. Gingival groove and dental canal fused.

Common canal roofed, and perforated by gingival tubules; *Cetotherium* Brandt.

The type of Siphonocetus is *Balæna prisca* Leidy. *S. expansus* Cope, and *S. clarkianus* Cope, sp. nov. belong to it. The type of Ulias is *U. moratus* Cope sp. nov. The type of *Tretulias* is *T. buccatus* Cope, sp. nov. To Cetotherium are referred *C. pusillum* Cope, *C. crassangulum* Cope sp. nov., *C. polyporum* Cope, and *C. cephalus* Cope. All the species of Balænidæ referred to are from the Yorktown (Middle) Neocene beds of Maryland, Virginia and N. Carolina.

Two New Species of Dinictis from the White River Beds. —The primitive saber-toothed cats are already represented in the genus Dinictis by three species; *D. felina* Leidy, *D. cyclops* Cope and *D. squalidens* Cope. To these may be added the two species described in this article, *D. fortis* and *D. bombifrons*. With the exception of *D. cyclops* from the John Day Beds of the Lower Miocene, the species are confined to the White River or Oligocene. Until the division of the White River,[1] no account of horizons was taken in collecting, but from the specimens at hand the range of the different species is indicated as follows: *D. fortis*, Titanotherium and Lower Oreodon Beds, *D. bombifrons* Lower Oreodon Beds, *D. felina*, Lower Oreodon to the Protoceras Beds.

[1] Divisions of the White River or Lower Miocene of Dakota, by J. L. Mortman, Bulletin American Museum, Nat. Hist., Vol. V, June 27, 1893.

Dinictis fortis sp. nov.

This species is based upon two specimens in the Princeton Museum, (number 11085 from the upper Titanotherium Beds and number 10933 from the Lower Oreodon Beds) which were collected by Mr. J. B. Hatcher in the summer of 1894. Number 11085, in which the front portion of the skull and the mandibular rami are preserved, is taken as the type specimen. Besides the skull there are present the distal end of the scapula, the humerus, most of the lumbar vertebræ, pelvis, proximal half of the femur, the tibia, astragalus and the bones of one digit. Of specimen 10933 there are portions of the skull showing the typical dentition and in addition to the bones of the type specimen there are the radius, ulna, scapho-lunar and additional foot bones and vertebræ, thus making it possible to give all the distinguishing characters of the species excepting those of the posterior portion of the skull.

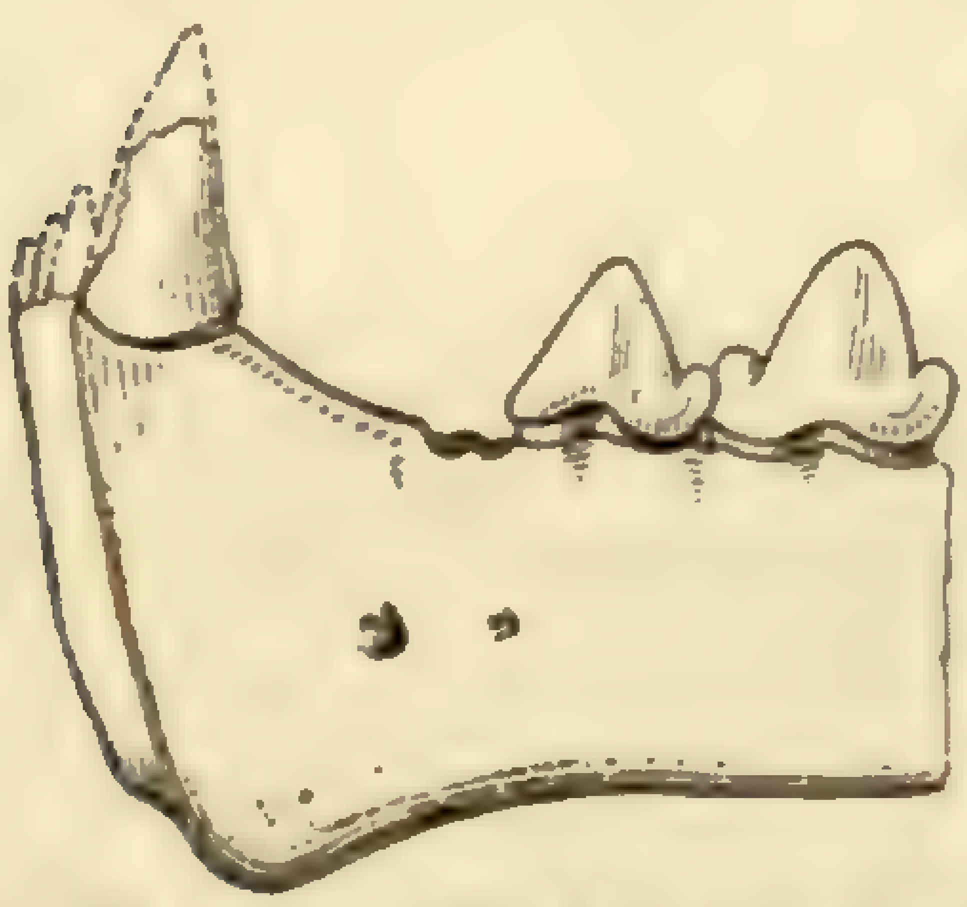
Fig. 1. *Dinictis fortis*, fragment of jaw, x ½.

Typical characters: The species differs from *D. felina* in that the muzzle is much shorter and broader and the orbital plate of the maxillary is larger and heavier. The differences in dentition are the entire absence of the paraconid of the second premolar, the larger upper canines and the more perpendicular set of the teeth as shown in the lower premolars. The skeleton is larger, the limb bones approaching in proportions those of *Hoplophoneus occidentalis* but with more slender shafts.

The Skull: The fact that the posterior portion is not preserved prevents the description of many important points, but the characters of the anterior portion are distinctive. The nasals are broader than those of *D. felina* and the premaxillaries are heavier and more rounded in their lower portion. The opening of the anterior nares is correspondingly broader. The maxillaries unite with the nasals and premaxillaries so as to form a regularly curved surface, in consequence of which the muzzle presents a rounded appearance. The orbital plate is heavier and extends farther forward, the anterior portion of the malar process of the maxillary being over the posterior root of the third premolar while in *D. felina* it is above the anterior root of the sectorial. This fact also has an important bearing on the shortening of the muzzle. The orbit is wider and the infra-orbital foramen is distinctly larger. The anterior portion of the palate is somewhat broader, otherwise it presents no special characteristics. The horizontal ramus of the mandible

is slightly heavier, the symphysis is broader and the flanges are less accentuated. There is a low rough tuberosity on the inner superior border of the ramus opposite the second molar, similar to that mentioned by Cope as occurring in *H. oreodontis.*

Dentition: In the type specimen the crowns of all the teeth are broken off but the fangs show the dental formula to be that characteristic of the genus, I. $\frac{3}{3}$ C. $\frac{1}{1}$ M. $\frac{1}{2}$. The superior canines are more robust than is indicated by the recorded measurements of *D. felina.* In specimen 10933 from the Lower Oreodon Beds, the crowns of the third and fourth inferior premolars are preserved. They are higher, the para- and meta-conids are less trenchant and the teeth are set more nearly perpendicularly in the jaw than those of the other Nimravidæ. There are no indications of a paraconid on the third premolar.

The fore-limb: The scapula presents a large glenoid cavity to correspond with the large articular surface of the head of the humerus. The neck is stout, the coracoid process is short and heavy, the spine is thick and shows the base of the metacromion. The head of the humerus is large and the greater tuberosity rises above it but slightly. The lesser tuberosity is low and rugose. The bicipital groove is broad and shallow, contrasted with that of *D. felina,* which is narrow and deep. The ulna and radius present no special characteristics excepting their relatively larger proportions. The manus of *D. felina* has not been described but from a specimen at hand it can be seen that it was small and narrow, thus agreeing in character with the pes which is already well known.[2] The manus of *D. fortis* agrees with these characters but the scapho lunar differs in that the tubercle is set off by a distinct groove.

The hind limbs are very similar in their markings to those of *D. felina* but on the femur the line from the third trochanter to the second is incomplete and the inter-osseous line of the tibia is very sharp and well marked. These characters are present in both specimens and are probably not due to individual variation. The knee joint seems particularly large, since the shafts of the limb bones possess something of the slenderness characteristic of those of *D. felina.* While the astragulus and calcaneum are heavy, the length of the fourth metapodial shows the pes to have been long. The unguals have incipient hoods.

In the type specimen there are preserved the lumbar vertebræ and the sacrum. In the other specimen twenty-nine vertebræ are present, all of which are more or less mutilated. These indicate an animal of

[2] Notes on the Osteology and Systematic position of Dinictis felina, W. B. Scott. Proceedings of the Academy of Natural Sciences, Philadelphia, July 30, 1889.

great strength especially in the lumbar regions. The pelvis is broad and rugose, the ilium and ischium being thick and stout.

This species extends the range of *Dinictis*, this being the first specimen reported from the Titanotherium Beds, and is interesting as being more primitive and pointing to a greater antiquity for the genus.

Measurements	D. fortis	D. felina
	M	M
Length of bony palate,	.075	.072
Breadth of bony palate (posterior edge)	.070	.069
Breadth between canines,	.030	.026
Length of upper molar series,	.048	.049
Breadth of upper incisor series,	.028	.029
Upper canine, transverse diameter,	.010	.008
Upper canine, fore and aft diameter,	.016	.012
Length of mandible from condyle,	.126	.119
Length of lower molar series,	.055	.052
Breadth of lower incisor series,	.015	.016
Lower canine, transverse diameter,	.004	.006
Lower canine, fore and aft diameter,	.005	.008
Humerus, length,	.192	.172
Humerus, breadth, proximal end, head and great tuberosity,	.043	.038
Humerus, breadth, distal end,	.047	.042
Radius, length,	.148	
Radius greatest diameter of head,	.020	
Radius breadth of distal end,	.030	
Ulna, length,	.191	
Ulna, distance from olecranon to beak,	.030	
Ulna, distance olecranon to coronoid,	.020	
Femur, length,		.190
Femur, breadth, proximal end (head and great trochanter)	.050	.038
Femur, breadth, distal end (greatest width of condyles)	.046	.034
Tibia, length, including maleolus,	.186	.168
Tibia, breadth proximal end,	.041	.034
Tibia, breadth distal end,	.027	.020
Calcaneum, length,	.055	.043
Astragalus, length,	.035	.027
Metatarsal IV, length,	.064	.053

Diniotis bombifrons, sp. nov.

A nearly complete skull and mandible, (number 10502 in the Princeton museum) collected from the Lower Oreodon Beds by W. H. Burwell establishes a second species new to science. Unfortunately there are no other parts of the skeleton associated with it, but its size and peculiar shape are sufficiently characteristic to distinguish it at once from the species already described.

Comparing this skull with that of *D. felina*, which is the type of the genus, it is considerably larger and proportionately longer in the posterior region. At the same time it is not so high, consequently the angle of the parietals with the frontals is greater. The most striking feature is the post-orbital constriction which is situated further back of the post-orbital processes than in *D. felina* and is more pronounced, being only 31 mm. in transverse diameter. This is the concomitant of a smaller cerebral capacity. On account of the cerebral fossa being less dilated, the zygomatic processes appear more distinct and the sagittal crest is higher. The frontals are bulging and in consequence there is a median depression. This conformation would seem to indicate an enlargement of the frontal sinuses. The nasals are broad and extend behind the maxillo-frontal suture, their line of union with the frontals forming a nearly perfect semi-circle. The infra-orbital foramen is depressed well into the maxillary. Tho premaxillaries with the incisors are absent from the specimens and the anterior portion of the maxillaries is weathered away, leaving the fangs of the large canines exposed. The hard palate does not differ materially from that of *D. felina*. The opening of the posterior nares is broad in front but narrow further back where the pterygoyds curve inward. The basal region is slightly longer in proportion, the paroccipital processes are more developed and are acute. The occipital condyles are much heavier. The foramen magnum is smaller and is nearly round. The supra-occipital is produced posteriorly so that its surface looks downward. The sagittal crest and lambdoidal ridge are thin and high. As seen from above the lateral margins of the occiput are parallel and the inion is regularly curved.

The mandible is longer, corresponding with the elongation of the skull and the flanges are low and heavy. The dentition is not essentially different from *D. felina* except in the large, compressed superior canines. The superior molar is somewhat reduced, the second inferior molar has a single root and is just on the point of disappearing, and there is a short diastema between the second and third premolars, but these characters may not prove constant. The postero-internal cusp of

the lower sectorial has been shown to be an inconstant character in the genus. In this specimen it is well developed.

MEASUREMENTS	D. bombifrons M	D. felina M
Length of skull, condyles to premaxillaries,	.185	.154
Length of skull including overhanging occiput,	.205	
Length of cranium to anterior rim of orbit,	.130	.108
Length of face,	.055	.046
Distance from anterior rim of orbit to post-orbital constriction,	.065	.050
Length of bony palate,	.074	.072
Breadth of bony palate, posterior portion,	.070	.069
Breadth between canines,	.025	.026
Distance from foramen magnum to line of post-glenoid process,	.039	.033
Distance from foramen magnum to line of mastoid processes,	.0195	.0195
Length of upper molar series,	.046	.049
Length of upper canine,	.050	
Upper canine, transverse diameter,	.010	.008
Upper canine, fore and aft diameter,	.019	.012
Length of mandible from condyle,	.132	.119
Length of lower molar series,	.055	.052
Lower canine, transverse diameter,	.007	.006
Lower canine, fore and aft diameter,	.110	.008

GEO. I. ADAMS.

Geological News, PALEOZOIC.—Mr. Beecher's study of a series of *Trinucleus concentricus* Eaton, a trilobite departing widely from the common form, substantiates the conclusions of Barrande as to the generic value of the ocular tubercle and eye-line. They clearly represent adolescent characters.

In regard to the appendages of *T. concentricus*, Professors Verrill and Smith agree that they indicate an animal of burrowing habit, which probably lived in the mud of the sea-bottom, after the fashion of the modern Limulus. In addition to its limuloid form, the absence of eyes favors this assumption, so does the fact that many specimens have been found preserving the cast of the alimentary canal, showing that

the animal gorged itself with mud like many other sea-bottom animals. (Am. Journ. Sci., Vol. XLIX, 1895.)

The eruptive rock in south central Wisconsin, classified as quartz porphyry by the state geologists, is described in detail by Weidman. The formation represents a volcanic outflow which took place over beds of Upper Huronian quartzite. The normal rock is a quartz keratophyre, but along the contact line with the quartzite occurs a zone of sericite schist from 150 to 200 feet wide. These schists are a dynamic alteration of the quartz keratophyre, and are not as Irving supposed, related to the Magnesian schists of Devil's Lake. A third type of rock belonging to the series is volcanic breccia varying in size from an inch to a foot in diameter. The areal extent of the eruptive rock is greater than was formerly supposed. It was during an elevation which followed the outflow, that the overlying porphyry was metamorphosed, in part, into schist. (Bull. Univ. Wisc. Sci. Ser., Vol. I, 1895.)

MESOZOIC.—M. Sauvage classifies the Dinosaurs found in the Upper Jurassic beds of Boulogue from 1863 up to the present time as follows:

Sub-order Sauropoda.

Fam. *Atlantosauridæ, Morinosaurus typus* Svg.; *Pelorosaurus precursor* Sog. Fam. ? *Dinosaurien* de *grande taille.*

Sub-order Theropoda.

Fam. *Megalosauridæ, Megalosaurus insignis* E. E. Desl.

Sub-order Ornithopoda.

Fam. *Iguanodontidæ. Iguanodon prestwichii* Hulke. (Bull. Soc. Geol. de France [1894] 1895.)

Geological News.—PLISTOCENE.—A study of the topography and distribution of the typical eskers of New England brings Mr. J. B. Woodworth to the conclusion that they are most easily explained by a subglacial origin, but segments occur where the cross-section departs from the limitations of the type and demands a channel open to the sky. (Proceeds. Boston, Soc. Nat. Hist., 1894.)

Mr. R. E. Dodge offers the following hypothesis to account for the terraces of the Connecticut River:

The Connecticut River occupies such a well-marked valley that it must have been the drainage channel of a large amount of water caused by the melting of the great glacier that overlay some portion of its valley. A part if not all of the waste in the terraces must have been

lain down during the presence of the ice. Afterwards a decreased volume and a rising land will account for the rest of the work done in postglacial times. In other words, the upper terrace plain is due to a glacial accident in the river's history, and the upper escarpment was formed as the river cut down toward base-level after the land rose when relieved from the weight of ice. The later terraces formed as the river sank its channel deeper into the glacial waste, each terrace plain representing the temporary level of the stream, and each escarpment showing intermittently rising land. (Proceeds. Boston, Soc. Nat. Hist., Vol. XXVI, 1894.)

A fossil mandible in the Museum at Brisbane, Queensland, is referred by Mr. De Vis to Zygomaturus. In commenting on the supposed identity of this genus with Nototherium Owen, the author says that this mandible shows the two genera to be distinct and that Zygomaturus, and its three allies, Diprotodon, Nototherium, and Euowenia, form a natural family of the phascolomine section of the marsupials. (Proc. Roy. Soc. Queensland, Vol. XI, 1895.)

BOTANY.[1]

Progress of the Botanical Survey of Nebraska.—From data recently obtained the following statement is made of the progress of the Botanical Survey of Nebraska. From its beginning, several years ago, the Survey has been a private enterprise, supported and encouraged by the University of Nebraska, the State Board of Agriculture, and the State Horticultural Society. The immediate work is in the hands of the Botanical Seminar, an organization of graduates of the botanical department of the University of Nebraska. Through the energy of the members of the Seminar expeditions have been made from time to time to nearly all parts of the State, and in some cases these have been of extended duration. The first considerable publication was made in 1890 when H. J. Webber's "Catalogue of the Flora of Nebraska" appeared in the Report of the State Board of Agriculture. Reprints of this catalogue were issued under separate cover, and these have formed the basis of subsequent work and publication. This catalogue, unlike many local publications of its kind, was based upon

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

actual specimens in the possession of the author, with a few exceptions where species were admitted on the authority of recent scientific publications.

In this catalogue 1,890 species were enumerated, almost equally divided between the flowerless and flowering plants. Important additions were made by members of the Seminar during the two years following the publication of the catalogue, and early in 1892, Mr. Webber published an "Appendix" to his first catalogue. This, with other additions published at the same time in a "Supplementary List," brought the whole number of species up to nearly 2,500 not quite equally divided between flowerless and flowering plants, the latter exceeding the former by about 150. A year later, 1893, in the "Report on Collections made in 1892" 162 species were added, and in the "Report for 1893" published in 1894, 184 additions were made, bringing the whole number of species (after making necessary corrections) up to abont 2,820, again almost equally divided between flowerless and flowering plants. The collections made last year, now nearly worked up, will amount to about 220 or more species, so that the list of known species now approximates 3,050. The flowerless plants now surpass the phanerogams, there being fully 1,600 of the former, to about 1,450 of the latter. From this time forward the ascendency of the lower plants is assured, since it is quite certain that by far the larger part of the flowering plants have already been catalogued.

Throughout the work, the original rule of basing all additions upon actual specimens has been adhered to, and in all the later work every specimen has been deposited in the Herbarium of the Survey. Some of the earlier collections are still in the private herbaria of members of the Seminar, but these will doubtless eventually be deposited in the Survey Herbarium also.

Along special lines a more particular study of the distribution of species has been made; thus the distribution of the woody plants has been mapped for each species, the whole including a series of small maps on which the area covered by each species is indicated by red-ink shading. In addition the data so obtained have been published in the bulletins of the Experiment Station (No. 18, 1891), the Annual Report of the Nebraska State Horticultural Society (1892), and the Annual Report of the Nebraska State Board of Agriculture (1894). Sixty-four trees and seventy-seven shrubs are now known to occur in the State, and their distribution is already quite well known.

The final reports of the Survey are to take the form of a systematic descriptive work, in which every species is to be fully described, accom-

panied by illustrations of all the genera. This publication is to bear the name "Flora of Nebraska" and will be issued in "parts" as the material is ready for publication. It is estimated that twenty-five parts of about fifty pages each, will be required to complete this work. In August of last year Parts I and II were issued. They cover the classes Schizophyceæ, Chlorophyceæ, Coleochæteæ, Rhodophyceæ and Charophyceæ, and are illustrated by thirty-six plates. Part XXII, the Calyciflorae, is nearly ready for the press, and will probably appear about the middle of the year. The plates, of which there will be eleven, are already made, and will illustrate the more difficult species and genera.

CHARLES E. BESSEY.

Pharmaceutical Botany.—A few months ago Professor Sayre's book "A Manual of Organic Materia Medica and Pharmacognosy" was issued by Blakiston & Co. of Philadelphia. An examination of the work, and some use of it in the laboratory show that it is well adapted to the use for which it was designed. The introductory chapters, devoted to an outline of Morphological and Structural Botany, will enable the student without other preparation to take up the work of the body of the book. The sequence of pharmaceutical products is strictly botanical, beginning with those which are derived from the Ranunculaceæ, and ending with Irish Moss from one of the Red algæ. The descriptions are good, and there are numerous illustrations, many of which are very good, while even the cruder ones will prove useful to the young pharmacist. Aside from its high value in pharmaceutical botany, it will be a useful reference book in any botanical laboratory.

Professor Bastin has recently added another useful book "Laboratory Exercises in Botany" (published by W. B. Saunders, Phila.) to his well known series. Although not distinctly so stated, it is especially suited to the wants of students in Medical Colleges, and those who are preparing to take up Pharmaceutical Botany, and for these it will be of much service. The numerous illustrations, while often not artistic, have the merit of making their meaning plain. The two books might very profitably be used together.

VEGETABLE PHYSIOLOGY.[1]

What becomes of the Flagella?—Some authors have insisted that the flagella of swarm spores are finally absorbed into the body of the spore, while others have maintained that they are cast off. In a recently published paper embodying the results of many careful examinations (Ueber das Schicksal der Cilien bei den Zoosporen der Phycomyceten) Rothert shows that both views are correct. In the second swarm stage of Saprolegnia and in the Peronosporeae the flagella are either cast off as soon as the spore comes to rest or soon after, or else they remain attached to the spore indefinitely, even after germination. In the first swarm stage of Saprolegnia, however, he found to his surprise that they are as uniformly drawn back into the body of the protoplasm, the withdrawal being slow at first and then quite rapid. In both cases, more especially in the former, the old flagella are strongly inclined to turn back on themselves and form fused loops, the reason for which is not very apparent. These loops are formed while the flagellum is attached to the spore or after it has been cast off and may occur in any part of it, the straight part of the flagellum being drawn back into the loop which becomes, thereby, little if any larger, but increases noticeably in thickness. These loops usually form within 1 to 3 minutes after the spore comes to rest. The author believes the looping movement is due to the vital activity of the flagellum, the subsequent drawing in of the straight part being accounted for by surface tension. He points out that purely physical causes would leave the flagella straight, or cause them to swell, or make them contract into balls. While not committing himself to the view, it is suggested that possibly the flagella are formed out of a special cytoplasm existing only in small quantity, and that at the end of the first swarm stage of diaplanetic swarm spores this is carefully husbanded for future use. The observations were made on Pythium complens, on a member of an undescribed genus nearest related to Phytophthora, on Saprolegnia monoica, and on an undetermined species of Saprolegnia, the spores being sown in hanging drops.—ERWIN F. SMITH.

Perithecial Stage of the Apple-Scab Fungus.—In *Berichte d. d. bot. Gesellschaft* XII, 9, pp. 338–342 R. Aderhold describes the

[1] This department is edited by Erwin F. Smith, Department of Agriculture Washington, D. C.

results of his observations and cultures, concluding that Venturia chlorospora f. Mali is the much sought for ascosporous stage of Fusicladium dendriticum (Wallr.). In culture media of apple and pear broth and the same with addition of gelatin, he found the mycelium and conidia obtained from the ascospores of the Venturia to be identical with those obtained from the conidia of the Fusicladium taken directly from the host plant. He did not succeed in growing perithecia either from ascospores or conidia, neither was he able to demonstrate that the scab can be produced by inoculations with these ascospores, owing to the fact that his experiment was tried in a locality where the disease made its appearance in unexpected abundance so as to confuse results. The evidence, therefore, rests on association and the supposed identity of the fungi which he obtained from ascospores and from conidia. The author states that without previous knowledge it was impossible to tell whether a given culture was derived from a conidium or an ascospore, and maintains that even without inoculatians he has fully established the genetic relationship of the two fungi, this argument will not, however, be fully convincing to others. The perithecia are round to oval with club-shaped, 8-spored asci; spores brown, 2-celled, the forward end smaller, 11–15x7–8μ. At Proskau in 1893, the asci were ripe the last of March, in 1894, the middle of April. In gelatin cultures the mycelium penetrated to the depth of a centimeter and formed superficially a dense black down, becoming gray-black with age. No pycnidia were observed, but round or oval pseudo-parenchymatic bodies finally formed in the cultures, and these were supposed to be incipient perithecia. Two closely related species of Venturia (V. chlorospora and V. ditricha f. piri) were found on old pear leaves attacked by Fusicladium, and because the extruded ascospores are exactly alike, so that the author could not tell with which he was working, the identity of apple and pear scab is also left for future determination. Altogether it would seem to have been better had the author held back the paper so as to include the results of another year, inasmuch as he intends to continue the investigation.—Erwin F. Smith.

Poisonous Cactaceae.—The reports of certain Mexican travellers (last of all Lumholtz) that the Indians of that region become intoxicated by eating certain species of cactus seem to have more truth in them than botanists generally have been willing to admit. Recently from Anhalonium Lewinii of northern Mexico, Lewin has isolated an alkaloid anhalonin, which is said to resemble the alkaloids found in many species of Strychnos. It was obtained pure, and both warm and cold

blooded animals were subjected to its effects. Per kilo of the animals experimented upon 0.02-0.04 grams caused severe poisoning and 0.16-0.20 grams caused death. This is not the only poisonous cactus. Four other species of Anhalonium (Echinocactus) were examined and found to be poisonous in varying degrees. Of the genus Mammillaria five species were examined, one of which (M. uberiformis) is noxious. More surprising still, the juice of Rhipsalis conferta was also found to be poisonous to cold blooded animals. The author thinks that other species of cacti will turn out to be poisonous, and expresses the hope that some of the alkaloids may be of service in medicine. These notes are from *Ber. d. d. bot. Gesellschaft*, XII, 9, pp. 283-290. Another paper by the same author giving the toxicological, chemical and crystallographical data in detail may be found in *Archiv f. ex. Path. u. Pharmak.*, Bd., 34, 1894.—ERWIN F. SMITH.

Rothert on Heliotropism.—The last number of Cohn's *Beiträge* (No. 1, Bd. VII, pp. VIII, 212) is wholly given up to a paper on Heliotropism by Dr. W. Rothert, privat docent of the University of Kazan. Many experiments were performed with monocotyledonous and dicotyledonous seedlings, leaf-blades, petioles and stems, and some interesting results were obtained which it may be possible to abstract hereafter. Among other things he concludes that Wiesner's "Zugwachstum" has no foundation in fact. There are no plates, but many simple figures illustrating curvatures are introduced into the text. The work was done in Leipsic in Dr. Pfeffer's laboratory.—ERWIN F. SMITH.

Austro-German Views on Botanical Nomenclature.—At the 66th meeting of the German Naturalists and Physicians held in Vienna in September, 1894, the section of Systematic Botany passed the following resolutions:

(1) The rule that a name once used but subsequently invalid shall never again be used is to be recommended for future observance, but retroactive power (once a synonym always a synonym) shall not be given to this rule, and names which have been changed for this reason shall be rejected.

(2) As a rule, the original species name is to be retained when a species is removed from the original genus to another.

(3) In questions of priority the year 1753 shall be retained as the point of departure both for names of species and genera.

(4) In the naming of species the principle of priority should govern, but a sure name shall not be thrust aside for a doubtful one.

(5) In the naming of genera a name that has been disused for 50 years shall not be revived to displace one which has been in use.

(6) This rule permits of one exception, i. e., when the name in question has been in use 50 years since its revival.

These rules were drawn by two botanists of world-wide reputation, Drs. Ascherson and Engler, and are accompanied by some pages of explanation and remarks which deserve the serious attention of all who are interested in nomenclature. It is unnecessary to say that Otto Kuntze and his followers receive considerable attention and plenty of sharp criticism. Of course, as Briquet has already remarked concerning the rules adopted at Rochester and those suggested by himself and other individuals, these rules must be adopted by an International Congress before they can have any binding force. Botanical nomenclature is an international affair, and the absurdity of a few individuals or even all of a certain country getting together and trying to dictate to the rest of the world is self evident. The rules here translated and the remarks alluded to will be found in *Oesterreichische Botanische Zeitschrift*, XLV, No. I, Jan., 1895, pp. 27–35.— Erwin F. Smith.

Separation of Enzymes.—The 18th An. Rept. Conn. Agricultural Exp. Sta. (1894) contains a number of papers of interest, notably three by Thomas B. Osborne on The Proteids of the Rye Kernel, The Proteids of Barley, and the Chemical Nature of Diastase. On methods of extraction, he has the following:

"The usual method of preparing vegetable enzymes is to treat the aqueous or glycerin extract containing them with alcohol as long as a precipitate having fermentative power appears, to purify this by repeated precipitation from its solution in water, by means of alcohol, and finally to subject the aqueous solution to dialysis to remove salts. This method is wholly unsuited to yield pure preparations, because the precipitate produced by alcohol contains not only a large amount of carbohydrates and salts, but also nearly all of the various forms of proteid matter present in the extract.

"The most rational method (hitherto very little used) is first to separate the proteids from the carbohydrates and other soluble substances by saturating the extract with ammonium sulphate, thereby precipitating the ferment and proteids together, next to remove the proteid existing as globulin, by dialysis, and then, if possible, to separate the albumin and proteoses by fractional precipitation with alcohol." By this method a diastatic ferment was isolated from malt which was capable at 20° C. of producing "from soluble starch, over 2000 times its weight of maltose, and a further undetermined quantity of dexterin, within one hour."—Erwin F. Smith.

ZOOLOGY.

Habits of Limpets.—It has long been known that the common limpet (*Patella vulgata*) settles down on some eligible spot (its "scar") between tide-marks, and makes a home, to which it returns after having been out to feed. This locality-sense has been supposed to be independent of smell, sight and touch, so far as the head tentacles are concerned. Mr. Lloyd Morgan, however, has shown (Nature, Dec. 6, 1894) that the head tentacles are the sense-organs concerned with this "homing" power. Later observations made by J. R. A. Davis, at the Scottish Marine Section, confirm Mr. Morgan's conclusions, to some extent, but Mr. Davis is inclined to think that the mantle tentacles may help in the homing.

Mr. Davis notes also that this homing faculty is not confined to Patella, but is also possessed by *Helcion pellucidum.* The object of this habit seems to be protection from the assaults of the incoming or outgoing tide. (Nature, March, 1895).

Life-History of the Lobster.—With a view to the artificial culture of the Lobster, Mr. Samuel Garman has undertaken to study the life-history of this animal, and has published the following notes on their breeding habits:

1. The female lobster lays her eggs but once in two years.

The normal time of deposition is when the water has attained its summer temperature, varying with seasons and places; the period extends from about the middle of June to the middle of September.

3. The eggs do not hatch until the following summer, that is, for a year. The time of hatching varies also with the temperature, and extends from the middle of May to the last of August.

The Gas in the Swim-bladder of Deep-Sea Fishes.—During the last scientific voyage of the yacht *Princess Alice*, commanded by Prince Monaco, M. Jules Richard had an opportunity of analyizing the gas in the swim-bladder of several species of deep-sea fishes. Serranus, from a depth of 60 meters, and congers, taken from a depth of 175 meters oft the bank of the Gorringe, showed more than 80 per cent. of oxygen. The rest of the gas was nitrogen with traces of CO_2. The proportion of oxygen was such that it was easy to perform the well known experiment of lighting a candle by holding one in the

gas, having previously lighted and extinguished it, leaving only a spark to start combustion. *Simenchelys parasiticus*, taken in a bow-net from 1674 meters' depth in the neighborhood of Corogne, showed 78 per cent. oxygen, that is to say, less than Serranus from 60 meters' depth. The law stated by Biot, that the proportion of oxygen increases with the depth is in default. Some other influences must be taken into account. (Revue Scientifique, April, 1895).

A New Locality for Abastor erythrogrammus.—I recently saw excavated from a clay bank on the Pamunkey River, Virginia, two specimens of the *Abastor erythrogrammus.* This is very far north of the most northern locality known in the east, which is South Carolina, although it has been found in the Austoriparian area in Southern Illinois. The locality mentioned is outside of that area and is in the Carolinian district. That the species is a burrower allied to Carphophiops is attested not only by its structure but by its habits. According to Mr. A. E. Brown, it has been dug from mounds in Florida at a considerable distance below the surface by Mr. C. B. Moore.

E. D. Cope.

The Cold-Storage Warehouse Cat.—A story has been going the rounds of newspapers, both west and east, to the effect that a new breed of cats has been produced in the cold-storage warehouses of Pittsburg. In some of the papers, reference was made to a new species of rat with the bodies clothed with remarkably long thick fur, with even the tails covered with a thick growth of hair. The rats had adapted themselves to a low temperature, and the cats were the result of breeding from artificial selection in order to obtain a cat to prey on the new rat. According to the story, after several failures, a brood of seven kittens, the progeny of a mother possessing unusually thick fur, was raised in the rooms of the storage company, and developed into sturdy, thick-furred cats, with shortened tails, and "feelers" five or six inches in length. This latter character was said to be probably due to their environment, since they must necessarily live in semi-darkness. Another peculiarity of the new cat is its inability to live in an ordinary temperature. When removed from the warehouse to the open air, especially in summer time, it will die of convulsions in a few hours.

This story was reprinted in England in some excellent scientific journals, which showed a great lack of caution in appropriating anything supposed to be new in science from a newspaper. It illustrates once more the English tendency to neglect the good and discover the

bad in American affairs. Mrs. Alice Bodington, however, redeemed the reputation of her countrymen by writing to the Secretary of the Cold Storage Co., to ascertain the facts in the case. She received the following reply:

"While there is some foundation for the newspaper article, it is somewhat exaggerated. Our cold storage house is separated into rooms of various sizes, varying from 10° to 40° above zero.

"About a year ago we discovered mice in one of the rooms of the cold storage house. We removed one of the cats from the general warehouse to the room referred to in the cold storage house. While there, she had a litter of several kittens. Four of these were transferred into one of the general warehouses, leaving three in the cold storage house. After the kittens were old enough to take care of themselves, we put the old cat back into the house we had taken her from. The change of climate or temperature seemed to affect her almost immediately. She got very weak and languid. We placed her again in the cold storage room, when she immediately revived.

"While the feelers of the cats in the cold storage room are of the usual length, the fur is thick and the cats are larger, stronger and healthier than the cats in any of the other warehouses."

Thus the only result of the change of environment was the usual one which ensues on the advent of winter in extratropical latitudes generally. It is interesting as showing that the effect is really produced by the low temperature, and is not a survival through natural selection of a chance variation, as a certain school of evolutionists would have us believe.

A New Harvest Mouse from Florida.—In a paper entitled "Contributions to the Mammalogy of Florida," published in the Proceedings of the Acrdemy of Natural Sciences of Philadelphia, in 1894, I had the pleasure of recording the first capture of a *Reithrodontomys* in Florida.

This specimen seemed to indicate good sub-specific characters in comparison with *R. humilis* of more northern latitudes, but owing to its apparent immaturity, I decided to postpone a description until other specimens were taken.

Subsequently, Mr. F. M. Chapman recorded, in the Bulletin of the American Museum of Natural History, of 1894, the taking of another specimen. The apparent rarity is confirmed by the experience of my friend Mr. Outram Bangs, who, in a list of about five hundred specimens of rodents taken by him in Florida the present winter (1894-5),

does not enumerate a single specimen of the Harvest Mouse. I have just received a second specimen from Mr. Dickinson, who sent me the first one, and, as this is an adult in perfect condition and fully confirms the peculiar characters of number one, it may form the type of the following diagnosis:

Reithrodontomys humilis dickinsoni.[1] Type ad. ♀, No. 2240, col. of S. N. Rhoads. Col. by W. S. Dickinson, at Willow Oak, Pasco Co., Florida, Apr. 6th, 1895.

Description: Size considerably smaller than *R. humilis.* Color above, uniform plumbeous gray, almost sooty, slightly darker along middle of back and rump, and a faint wash of light brown on sides. Tail above like back; below, grayish, like feet and under parts. Skull as in *humilis,* but distinctly smaller.

Measurements: Total length, 118; tail vertebræ, 56; hind foot, 15. Skull, total length, 18·3; basilar length, 13·6; length of nasals, 6·1; interorbital constriction, 3·1; zygomatic expansion, 9·6; length of mandible, 10; width of mandible, 4·7 mm.

This race of the common eastern Harvest Mouse conforms to the peculiarities of the Floridian as contrasted with the Carolinian environment in the same way that its allies and neighbors of the genera *Sigmodon* and *Peromyscus* have done, *viz.,* in the diminuition of brown and rusty colors and the acquirement of a more or less darkened shade of gray.

—Samuel N. Rhoads.

EMBRYOLOGY.[1]

Grafting Amphibia.—Professor G. Born has published a preliminary notice[2] of some novel experiments made upon the young tadpoles of various amphibia.

In studying regenerative processes in young tadpoles he observed that when a tadpole was cut into two pieces, the pieces might unite

[1] Named for Mr. W. S. Dickinson of Tarpon Springs, Fla. in recognition of of his valuable services in the collecting of Florida mammals.

[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts, reviews and preliminary notes may be sent.

[2] Jahresbericht d. Schlesischen Gesell. f. vat. Cultur Sitz., June 8, 1894.

again if kept close together. This led to a series of experiments that, at the time of publication, furnished the results enumerated below.

He used larvæ that were ready to escape from the egg jelly or those that had just escaped. They were put into 6% solution of sodium chloride and cut across with scissors or a scalpel into an anterior and posterior half. The pieces were at once brought together and held in place by various means till they grew together completely. Subsequently they were transferred to a fresh supply of the salt solution. It was found to be easy to get two tail pieces to unite, since the cilia that normally move the animal forward would push the two tails toward one another. With other pieces various artificies were necessary to prevent the ciliated action or the muscular contraction moving the wounded surfaces apart before union had taken place.

1. When the tail ends of two tadpoles of *Rana esculenta* are placed with the cut ends together, they unite in twenty-four hours quite completely, so that there is little external evidence of the line of fusion. These joined tails live for eight days and increase in length; they then degenerate and become dropsical.

The union may be made direct with the dorsal and ventral sides continuous in the two, or inverted with the dorsal of one continuous with the ventral side of the other. When very long pieces are taken a heart may develop in each, while in seven days there is an increase in length, for the two, of 2.9 mm. from a length of 15.6 mm.

It is also possible to unite such a long posterior part with a shorter posterior part; then the head of a larva is replaced by the tail and belly of another growing forward in its place.

2. The anterior ends of two larvæ may be made to unite. This succeeds more readily with the younger stages. Here again the union may be direct or inverted. In one case of the latter method of fusion, two that had been cut across in the region of the liver, remained united for fourteen days, during which time much differentiation took place in each head.

In the larvæ of the newt, triton, union of anterior pieces was affected, but this was less complete than in the case of the frog tadpoles.

3. Complex unions of two larvæ may result when the cuts are not quite complete and the two pieces of each remain connected by a slender bridge of tissue; the two pieces may be folded back side by side, and then pushed against the similar pieces of the other larva. The opposite ends of two larvæ may then fuse together while still remaining attached to their own proper terminations.

4. The anterior part of one larva may be united to the posterior part of another individual.

When the pieces are long, the same region is repeated in the resulting fusion, since it is present in the posterior part of one larva and in the anterior part of the other. In only one case, however, did this experiment succeed. After five days there had been much growth, but the intestine had not fused across the line of union and there was no circulation in the posterior piece.

5. Two frog larvæ may be easily united belly to belly so that a true twin is formed.

The animals may be united with the ends reversed as well as with the heads and tails in the same direction.

6. It is even possible to unite larvæ of different genera even of different families.

The posterior end of a frog larva was fused to the anterior end of a triton larva.

The anterior end of a frog larva and the posterior end of a toad larva (*Bombinator igneus*) were readily united. The inverse of this last experiment also succeeded.

7. The larvæ of *Rana esculenta* and *Bombinator igneus* were united belly to belly, producing a true double monster, gastrophagus, made up of animals of two different genera.

The Embryo of the Duckbill.—At the meeting of the Linnean Society of New South Wales, Nov. 28, 1894, J. P. Hill and C. J. Martin read a description of an embryo of the duckbill taken from an intrauterine egg. The embryo described was taken from one of two eggs just ready to be laid. The egg measured 18 mm. by 13.5, being somewhat larger than the eggs described by Caldwell. The embryo was found lying on the surface of a thin-walled vesicle with its long axis corresponding to the long axis of the egg.

It measured 19 mm. in length from the anterior end of the medullary plate to the posterior end of the primitive streak. The vesicle on which the embryo lay consisted of two layers all over, with the mesoderm extending about half way round between and comparable to a typical mammalian blastodermic vesicle. The vesicle filled the whole of the egg, and contained a thin albuminous fluid together with a thin layer of yolk spheres next to its wall. The embryo with the exception of a slight head fold, is quite flat. Medullary folds are absent except in the most anterior region of the future fore-brain, where slight lateral upgrowths of the medullary plate appear. The three cerebral vesicles

are indicated, and in the region of the hind brain four well-marked neuromeres exist. External to the 2d, 3d, and 4th neuromeres is an extensive auditory plate, already slightly grooved. There are seventeen somites, which, in the middle region of the trunk, possess distinct cavities, and externally to these from the 4th to the 17th, are situated the beginnings of the Wolffian bodies. At the 7th somite the Wolffian duct is first seen, the appearance of which in sections suggests an ectodermal origin. Double heart origins are present, but there is no trace of a vascular area besides a slight mottling in and around the area pellucida. A distinct blastopore is present with a neurenteric canal, which runs through the head process and opens into the archenteron (yolk-sac cavity). The primitive streak extends behind the blastopore to a distance of 1.5 mm. The embryo more nearly resembles that of the Virginia opossum (Didelphys) of 73 hours described by Selenka, than any other embryo known to the authors. The Platypus embryo is, however, much longer.—Zool. Anzeiger, 1895, p. 31. K.

ANTHROPOLOGY.[1]

The Antiquity of Man in North America.—The problem of the antiquity of man on this continent has received some interesting contributions within the last few years, and it will be interesting to take a survey of its present condition.

The sources of information respecting the first human inhabitants of a country are four-fold—two-fold as to materials, and two-fold as to localities. The materials may be either his bones or his handiwork ; the localities are deposits which are either within caves or outside of caves. The bones of primitive man have shown that there was, in Europe, and possibly in Asia (Java), a species of the Genus Homo distinct from the *H. sapiens*, which has been called *H. neanderthalensis*. This being possessed all the characters of the skeleton, dentition, etc., which belong

[1] This department is edited by H. C. Mercer, University of Pennsylvania.

to the lowest existing races of men, and had, in addition, a transverse ridge across the inner side of the symphysis of the lower jaw above the genioglossal tuberosity, from which it is separated by a deep transverse valley. Nothing like this occurs in any existing race of the *Homo sapiens.* If any person is disposed to dispute the claim of the *Homo neanderthalensis* to recognition as a species, let him reflect that the diversities presented by the existing races of the *Homo sapiens* are, in some instances, of the kind regarded in zoology as both specific and even generic, and that they are not so regarded is because of the existence of numerous intermediate forms. The peculiarities presented by the Neanderthal man (including, in this term, the people of Spy, Naulette, Shipka, etc.), found in a few of the lowest races are the small cranial capacity, the larger size and quadrituberculy of the last superior molar, etc., while the conformation of the symphysis is not seen in any of them, and is of such a character as to indicate wide divergence in zoological affinity. His small cranial capacity has been shown by Virchow to be matched by that of a Nigrito of the Andamans, where it is as low as 950 ccm., an inhabitant of New Britain, 860 ccm.; Nilgiri, India, 960 ccm.; New Ireland, 970 ccm., and of Abyssinia 975 ccm. No trace of the skeleton of the Neanderthal man has been found in North America. The skull found in the Gold Bearing Gravel of Calaveras Co., California, was without lower jaw, so that its specific position cannot be determined. The cranium proper, however, does not resemble that of the older species. The same is true of the man of Sarasota Bay, Florida; and the man of the baths of Peñon near the city of Mexico had the usual type of lower jaw. For the present, then, this species of man may be left out of account in the present discussion.

Whether, after the subtraction of the Neanderthal species, the history of *Homo sapiens* can be divided into a paleolithic and a neolithic age, or whether the Neanderthal man was the only paleolithic man, remains for consideration. The man who made the turtle-backs of the gravels of the valleys of the Thames and of the Somme, is supposed to be truly paleolithic. Mr. Boyd Dawkins finds, however, that their bone fishing-spears are identical in character with those made and used by the (Esquimaux) Inuit, and he suggests that, in the glacial period, these people existed in southern Europe with the reindeer and other arctic mammals appropriate to the climate. And now comes Mr. Frank Cushing, who declares that not only the spears, but all the other bone instruments and implements of reindeer-horn and bone found in the

[2] Verhandlungen d. Berliner Anthrop. Gesselsch., 1894, p. 506.

French caves, and supposed to be of paleolithic age, are now in actual use among the Inuit of the Arctic regions of America. The coincidence covers so many kinds of implements, and the appropriateness of the environment is so plain, that the conclusion is almost irresistible, that the river valley paleolithic people were, as Boyd Dawkins supposed, Inuit. But no crania or jaws of these people have been discovered, so that it is not known whether they possessed the dental characters which I have shown to characterize this race.[3] It would be remarkable for this race to have immediately succeeded the Neanderthal man in Europe, since the two present dental characters at the extremes of the range of variation in the Genus Homo, so that they would be regarded as good genera zoologically speaking, were it not that the rest of mankind intervenes between them. Bone barbed spear heads of the Inuit pattern have been found in Ohio. The neolithic men of Europe do not differ in cranial or dental characters from the majority of men, so far as they are known. They were not Inuit.

It is well known that Messrs Holmes[4] and Maguire[5] have endeavored to prove not only that there was no paleolithic man in North America, but that his existence in Europe is problematical. Paleolithic flints they regard as rejected cores from which fragments have been split for the manufacture of better implements. European authorities do not admit this, but maintain the validity of paleolithic man. The question to my mind is, however, more complex than it was. If the Neanderthal man is the paleolithic man, then he existed beyond a shadow of a doubt. But the river-drift men were totally distinct, probably Inuit. Did any other paleolithic man exist? The chances of proving the existence of such a man in Europe are diminished but not extinguished.

If we turn to North America, the evidence of the existence of any man but the so-called Indian on this continent is insignificant compared with the evidence for primitive man which exists in Europe, but, such as it is, it is important. Paleolithic flints have been found at Little Falls in Minnesota, at Newcomerstown in Ohio, and paleolithic argillites near Trenton, New Jersey, in beds of plistocene age more or less related to glacial conditions. The attempts of Mr. W. H. Holmes to discredit these alleged discoveries does not appear to me to be successful. His criticism of the great manufactory of turtle-backs at Piney Branch near Washington, D. C., which he believes to be the refuse of an arrow

[3] Amer. Journal of Morphology, 1888, p. 7.

[4] Journal of Geology, 1893, p. 147; American Geologist, 1893, p. 219.

[5] American Anthropologist, 1893, p. 307; American Naturalist, 1895, p. 26.

factory, is worthy of closer attention. In any case, the evidence from glacial deposits of the existence of paleolithic man in America is not yet very considerable.

If we turn to the caves, we have, at least, the opportunity in this country of demonstrating the existence or non-existence of Cave Dwellers. Between 1868 and 1871, I explored the contents of three ossiferous caves; one in Tennesee, one in Virginia, and one in Pennsylvania. No report was made on the contents of the first, as the material was sent to a museum in Philadelphia and was never seen after. Reports[6] on the other two were published. All of these caves are situated south of the terminal moraine of Lewis and Wright. A report on the contents of Hartman's Cave in Northampton Co., Pennsylvania, within the line of the terminal moraine, was made[7] by Professor Leidy in 1887. These investigations brought to light the existence of a definite fauna, which I have called the Megalonyx fauna, and which is the last of the extinct faunas of North America. It includes the extinct genera of Mammalia, Platygonus, Smilodon, Megalonyx, Mylodon, Mastodon, and extinct species of Bos, Dicotyles, Equus, Tapirus, Ursus, Castor, Arvicola and Lagomys. Teeth and other fragments are found which are not distinguishable from the following species now existing in the country; *Cervus virginianus, Canis lupus, Ursus arctos, Vulpes virginianus, Procyon lotor, Didelphys virginianus, Lepus sylvaticus, Arctomys monax, Castor fiber.* These remains are enclosed in a red calcareous clay, which, when dry, forms a matrix of moderate hardness, similar to that observed in the bone caves of Europe and Asia.

It may be here remarked that the bone caves of the world so far as explored, present us with an oldest fauna of about the same age. They nowhere include fossil remains of animals of an age prior to the Plistocene. This I have had occasion to verify on specimens brought from the caves of Mount Carmel, Syria by Sir William Dawson, as well as on the American material already mentioned, and as has been long since shown with regard to the caves in Europe. And this in spite of the fact that bone caves exist in all limestone formations from the Cambrian upwards, and have doubtless commenced their formation so soon as the respective limestones were sufficiently elevated to be subject to the soluble and erosive effect of water flowing in its fissures. The plain inference is that all those parts of the caves which represent this

[6] Proceeds. Amer. Philos. Soc., 1869, p. 171. Ibid., 1871, p. 73.

[7] Annual Report of the Geological Survey of Pennsylvania, 1887, p. 1.

work which was accomplished prior to the Plistocene age with their contents, have been removed by atmospheric and other erosion.

The explorations in American caves conducted by Mr. H. C. Mercer of the University of Pennsylvania in the last two years, have thrown interesting light on the subject. He examined some twenty five caves[8] and rock shelters situated in the valleys of the Tennessee, Kanawha and Ohio Rivers with great care, digging trenches to bed rock, noting the deposits in their bottoms, and saving all the fragments met with, carefully classified as to position, etc. *In only one of these did he find a slight trace of the Megalonyx fauna,* and in this case only in a stratum at the bottom. In all the others were found the bones of the existing wild fauna of the country, the mammalia, birds, reptiles and fishes, with bones, pottery, and flints of the American Indian. The sole exception mentioned was the Lookout Cave, Tennessee, where in a bed of red clay at the bottom, there were found a jaw of a *Tapirus haysii,* and of a small Mylodon. The cave deposits encountered were loose and nowhere indurated as in the caves containing the Megalonyx fauna explored by myself. It is perfectly clear from these results that there exist cave deposits of two ages in eastern North America, the one containing the existing fauna and the Indian, and the other containing the Megalonyx fauna, *and which has so far yielded no traces of the existence of man.*

What cause exterminated this populous fauna of large and small Mammalia from the North American Continent? Some of its features are distinctly South American. Such are the genera of sloths, Mylodon, and by relationship Megalonyx, although the genus did not occur in the Southern Continent. Such are the genus Smilodon, and the species of peccaries and tapirs, and the great rodent Castoroides which probably belongs to the same. The nearest approach to members of this fauna in N. America are the peccary of Texas and the tapir of Mexico. The appearance of the caves of this period throws some light on the question. The Virginian bone breccia which I examined was the floor of a cave only, the cave itself had been carried away by some powerful agency. The Tennessee cave was a steeply descending shaft which had been filled to the mouth. I found it most convenient to break from the roof of a hole which pierced the deposit, the fragments of matrix which contained the bones. The cave at Port Kennedy on the Schuylkill River, Penna., is a fissure, and it is packed from floor to opening with alternating deposits of clay and vegetable

[8] American Naturalist, 1894, pp. 355, 626.

debris mixed with fragments of limestone and wood. In my opinion all of these caves have been submerged, and their contained deposits are rearranged sediments. The later caves have not been submerged since they received their present contents. The difference in the age of the respective deposits is, then, considerable. In the case of the Lookout Cave, Tennessee, explored by Mr. Mercer, a part of the old cave deposit remained, and was covered by the modern bed.

Geologic history presents us with a submergence at the middle of the Plistocene period, precisely such as constitutes the culminating point of every geologic system. This has been termed by Dana the Champlain epoch, and we may well retain the name in a broadened sense for the continental submergence to which we owe not only the Champlain and Erie formations of the North, but the Columbia gravels of the Middle and Southern States, so thoroughly studied by McGee. That the submergence was not without short reversed movements and oscillations has been shown by Spencer, but that it was continental in extent there can be no doubt. It is also clear that it was followed by an emergence, which constitutes the Terrace epoch of Dana's system. We are then led to the conclusion that the fauna of the Megalonyx epoch is pre-Champlain, and that of the later caves post-Champlain. The country was, however, not probably wholly submerged. Some species, mostly the smaller ones, and the genus Megalonyx, survived on the not submerged land, and these we find to be common to the two faunas. The Hartman's cave, within the limit of the ice sheet, is on a hill now elevated 800 feet above the level of the Delaware River. That it was subjected to submergence is shown by the stratified clay with which it is even now partly filled. Its fauna does not include all the types of the Megalonyx fauna, and does include the Castoroides, as shown by Leidy. It includes a larger proportion of existing species than the usual Megalonyx fauna. Its peculiarities are probably due to its northern latitude.

This submergence corresponds with the one which Professor Prestwich insists effected Europe subsequent to the glacial elevation.[9] The Paleolithic flints of Kent he thinks demonstrate such a submergence, and his reasoning as to the character of the deposits in the European caves applies exactly to the bone breccias of the Megalonyx age of our caves here.

The existence of Paleolithic man in North America has not yet been demonstrated by the cave explorations so far as they have gone. We can, however, only consider this conclusion as one which may be re-

[9] Transac. Royal Soc. London, 1893, p. 903.

versed at any time. The state of affairs on the Pacific Coast may be stated as throwing considerable light on the subject.

The Equus beds are found covering areas of various extent in Oregon, Nevada, California, the Staked Plains, Southern Texas, Chihuahua and the valley of Mexico. Their most eastern station is western Nebraska. They contain a fauna which includes one extinct species (*Equus major* Dek.) of the Megalonyx fauna, and the recent *Castor fiber.* They contain the extinct genus of sloths Mylodon, of a species different from that of the east, and four species of camels of the extinct genus Holomeniscus, and a peccary. Recent species of Canis and Thomomys occur, while two extinct horses (*Equus occidentalis* Leidy and *E. tau* Owen) are common. The hairy elephant (*E. primigenius*) is abundant, while the *Mastodon americanus* is rare, if occurring at all. The proportion of recent to extinct species and genera in the Equus bed fauna is very similar to that occurring in the Megalonyx fauna, while they differ as to details.[10] This fauna has also disappeared from the continent, a few species, as in the east, surviving to a later date. Was its disappearance due to a submergence as in the east? The appearance of the beds in Texas leads us to suppose that such was the case; while the deposit in Oregon appears to me to be that of a lake now desiccated. The gold-bearing gravel of California, which is also Plistocene, must have been the result of floods, and its wide distribution and stratification resemble conditions due to submergence. Whether the Equus fauna was destroyed more or less by submergence or not, the rëelevation of the Sierra Nevada introduced a period of desiccation to the east of it, before which all large mammals remaining must have succumbed.

The remains of man have been shown to occur in the gold-bearing gravels. I have found them (obsidian spear and arrow heads) in profusion mixed with the bones of the extinct fauna at Fossil Lake, Oregon, in a friable and wind-blown formation. This man, however, so far at least as regards California was not Paleolithic, since he made smoothly ground pestles and mortars.

There is, therefore, considerable probability that man was a contemporary of the Equus fauna, and the Equus fauna was contemporary with the Megalonyx fauna of the east.—E. D. Cope.

Paleolithic Man.—*To the Editor of the American Naturalist:—*

Dear Sir:—In the January number of your estimable Journal,

[10] See American Naturalist, 1889, p. 160, for a partial list of the species of this fauna.

there appeared on page 28, the following statement: "* * *in America the friends of paleolithic man have with few exceptions deserted the proposition as an unsupportable theory.*"

Without raising any discussion upon the theory of the paleolithic age in America, I desire to enter my protest against the correctness of the foregoing conclusion.

There may be those who believe the existence of a paleolithic period in America is not yet proved; who only believe in its probability and do not reject the evidence cited in its favor; but of all those thus classed, I know of none who "have *deserted the proposition as an unsupportable* theory."

Respectfully,
Thomas Wilson.

The Smithsonian Institution, Washington, Jan. 30th, 1895.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History.—April 17th—The following paper was read: Prof. William Libbey, Jr., "Two Months in Greenland;" stereopticon views were shown.

May 1st.—The reports of the Curator, Secretary, Librarian, Treasurer and Trustees were read, also the report of the Walker Prize Committee. The election of officers for 1895–96 was held. The following paper was read: Mr. J. L. Tilton, "On the Geology of the Southwestern Part of the Boston Basin."

May 15th.—The following papers were read: Prof. Thomas Dwight, "Notes on the Dissection of a Chimpanzee, with Especial Reference to the Brain." Prof. N. S. Shaler, "The Conditions of Escape of Gases from the Interior of the Earth."—Samuel Henshaw, *Secretary.*

Academy of Science of St. Louis.—April 15th.—Miss Mary E. Murtfeldt presented a paper on "The Habits of Certain Seed-Feeding Insects."—A. W. Douglas, *Recording Secretary.*

American Philosophical Society.—April 19th.—Dr. D. G. Brinton read a paper on the "Proto-historic Ethnography of Western Asia."

May 17th.—Dr. D. G. Brinton read an obituary notice of the late Dr. W. S. W. Ruschenberger. Mr. R. Meade Bache made a few remarks on "Personal Equation." Prof. E. D. Cope read a paper on "The Pamunkey Formation of the Chesapeake Region and its Fauna." Mr. J. G. Rosengarten read an obituary notice of the late Prof. Henry Coppée.

Proceedings of the Natural Science Association of Staten Island.—Dec. 8th, 1894.—Mr. Walter C. Kerr exhibited numerous maple leaves injured by storm and read the following:

Survival of Storm-Injured Leaves—During the last summer it was frequently remarked that the late spring frosts had seriously injured the young foliage, several gentlemen having commented upon the damage thus wrought to their shade trees. My attention was first attracted, on May 27th, to the wilted appearance of the leaves of a white oak on Richmond terrace, near Stuyvesant place, and later to the similar condition of the Norway maples on DeKalb street. A search for parasitic fungi as the cause revealed nothing, and it was not until a gardener suggested the wind that the true explanation appeared. This, perhaps, should have been more apparent, although few seem to have suspected the real cause. The damage was so general that it contributed a conspicuous feature to our summer's foliage throughout our eastern and southern exposures, as has already been incidentally mentioned in the Proceedings for October in connection with the effects upon the Cicadas.

The storm, which lasted several days, began on May 20th, and the trees then in foliage all suffered more or less, the extent of damage seeming to be proportional to the size of the leaves. The white oaks and the maples having the largest leaves at that season, were lashed and bruised in a somewhat interesting, if not remarkable, manner. Fruit trees were also considerably injured. Few, if any, leaves were killed. They seem rather to have been injured in spots, chiefly at the tips, though also along the edges and through the blades of the leaves, extending inward from the sinuses, withering at these points while the remainder of the surface was unharmed. Some were split radially along their weakest sections, withering on the edges of the split. In some, over three-fourths of the surface was killed, the shape, however, being preserved intact, the other fourth remaining green and healthy. It is difficult to describe their appearance, but the specimens submitted will indicate the peculiar way in which they were affected by the injury. The general appearance of the trees has been too common all summer

to require special comment. Similar injuries are reported by Mr. William T. Davis and Mr. Charles W. Leng, as observed, especially on the leaves of oaks and maples, at Newfoundland, N. J., where a high ridge furnishes opportunity for exposure.

With easterly storms so prevalent on our coast, it is strange to find so conspicuous a result from a storm possessing no unusual characteristics, and the simplest explanation would obviously be that it occurred just at a time when many leaves were sufficiently young and tender to receive the injury, yet old enough to survive it—a combination that might not often occur.

Mr. Wm. T. Davis exhibited specimens of dragon-flies and read the following:

Two Additions to the Local List of Dragon-flies.—The dragon-fly, *Libellula axillena* Westwood, form *vibrans*, was quite numerous last August in various parts of the island, both near ponds and in woodland. If persistently disturbed, they often flew into the highest trees. The first one was seen on August 4th in the valley of Reed's basket-willow swamp. In capturing it the abdomen was knocked off, and the remainder of the insect, true to what I afterward found to be the custom of the species, flew into a tree. Several missles induced it to change this perch for a less elevated one, and it was finally placed in the cyanide bottle. Previous to the summer of 1894, this dragon-fly had not been seen on the island, and it is an interesting fact that it eventually came in such numbers.

Two small specimens of *Diplax semicincta* Say, were taken on the 15th of last July at the small ponds of the old iron mines near Four Corners. This locality is also the only one on the island where *Nannothemis bella* Uhler has been found.

With these two additions, the species belonging to the sub-family *Libellulinæ*, so far collected on the island, number twenty-two. Mr. Calvert reports but twenty-four species from the vicinity of Philadelphia.

Minor Notes.—Mr. Arthur Hollick reported that an oppossum was captured on December 6th, at New Dorp, by Mr. Richard Britton. It was found in a shallow burrow in the ground, near the foundation walls of an old ruined house, and was easily unearthed. The animal was killed and has been sent to a taxidermist for mounting. From the appearance of the locality, Mr. Britton is of the opinion that a colony of the animals is living there.

Mr. Wm. T. Davis exhibited a small Indian stone paint pot, recently found at Tottenville. This is the first utensil of the kind reported from any of the collections made on the island.

Mr. Davis also exhibited a large yellow gravel pebble, consisting of a mass of silicified coral (probably an *Eridophylum*) found by Mr. Trigg on the shore at Eltingville.

March 9th, 1895.—Mr. Fred. F. Hunt read the following paper, illustrated by samples of the articles mentioned and tubes containing the tests made:

Arsenic in Wall Paper and Hangings.—Having had occasion lately to test some wall papers and hangings for arsenic, it may interest our members to know of the results obtained.

These tests were made on account of sickness, apparently a case of poisoning, which could not be traced to any cause. On finding that all the rooms in the house, except one, had arsenical wall paper, and also that some curtains and furniture covering carried arsenic, the doctor attributed the illness to that cause, and this view seems to have been borne out by the recovery of the patients on the removal of the arsenical materials.

The house is an old one, on this island, and some of the rooms had four papers on the walls. For testing, the papers were taken off to the plaster, and one test made of all the papers that were in one room together, so I am unable to say which carried the arsenic. The test used was the " Marsh test." All the rooms in the house that were papered, except one, and also the hallways, carried arsenic in larger or smaller quantities, some tests requiring the gas to be passed for ten minutes before showing the arsenic mirror, while others showed it after a few seconds, and one test gave the largest amount I have found in any wall paper.

It is generally supposed that a paper must have green in it to carry arsenic, but that is not so, as I have found it in nearly all colors; one ceiling paper, which has a ground of very light yellow with a gilt pattern on it, carried notable quantities of arsenic, while other papers that were different shades of green, carried none; in fact, my experience has been that the browns, reds, yellows and grays are the most likely colors to carry arsenic.

The cartridge papers do not carry arsenic, as far as my experience goes, even if there is a pattern printed on them. This may be due to its being a comparatively modern wall paper, and the manufacturers having found that of late years there has been more or less agitation on the subject of arsenic in wall papers, are more careful in the pigments they use.

A set of red-brown colored chenille curtains in this same house gave a very marked mirror of arsenic, although they had been in use for

some time in another house; a jute-velour furniture covering, color old rose, also gave the arsenical mirror, and a crêtonne of a black ground with light colored figures and pattern was highly charged with arsenic, even after several years' use as curtains, indicating that use does not eliminate the arsenic. Tests were made of 60 pieces of lately imported English crêtonnes, and only 20 pieces were found to be free of arsenic. In Germany and, of late years, in France, there are laboratories supported by the government, where anyone may take a substance believed to be injurious to health, to be tested free of charge, and, as there is a punishment for selling any such substance, fabrics from these countries are very likely to be free from deleterious matter.

There are two ways in which the arsenic may be disseminated in the air, first, by a chemical action forming arseniuretted hydrogen, which readily comes through any paper that may cover the arsenical one; second, a purely mechanical action, where the arsenical paper is outside, by the pigment or sizing, drying and being carried off as a powder and breathed—both these actions may be taking place with an arsenical outside paper.

SCIENTIFIC NEWS.

The Eighth Session of the Marine Biological Laboratory at Wood's Hole, Massachusetts, will last from June 1 to October 1, 1895. The laboratory is under the general charge of Prof. C. O. Whitman, Director, and Prof. H. C. Bumpus, Assistant Director.

Instruction will be given by the following staff: Howard Ayers, E. G. Conklin, S. Watasé, M. M. Metcalf, C. M. Child, F. R. Lillie, O. S. Strong, H. S. Brode, W. M. Rankin, J. L. Kellogg, P. A. Fish, A. D. Mead, H. E. Walter, W. A. Setchell, W. J. V. Osterhout, Jacques Loeb, W. N. Norman.

There will also be evening lectures on biological subjects of general interest. Among those who may contribute these lectures may be mentioned, in addition to the instructors above named, the following: G. F. Atkinson, E. G. Conklin, J. M. Coulter, A. E. Dolbear, Simon Flexner, E. O. Jordan, William Libbey, Jr.; F. S. Lee, W. A. Locy, J. M. Macfarlane, C. S. Minot, E. S. Morse, H. F. Osborn, W. B. Scott, W. T. Sedgwick, William Trelease, S. Watasé, E. B. Wilson, B. G. Wilder, W. P. Wilson.

The following courses of instruction are offered:

In the laboratory for teachers and students in anatomy which will be open from July 2 to August 30, two courses are offered: the first, in invertebrate anatomy, and the second, a newly arranged course in vertebrate anatomy. Either course may be made preparatory to the course in embryology. The course in invertebrate anatomy will embrace a study of the more typical marine invertebrates, instruction being given by lectures, laboratory work and collecting excursions. The lectures are given each morning, and by those who are specialists in the subject under consideration. For laboratory dissection, each student is supplied with fresh material, and the entire day is spent in study, under the direction of the instructors. Collecting excursions are taken on Wednesdays and Saturdays. The steam launch and boats are freely used, and methods of dredging, skimming, and general collecting are explained. The animals studied will be Grantia, Tubularia, Campanularia, Metridium, Mnemeopsis, Nereis, Phascolosoma, Polyzoa, Bdellura, Molgula, Branchipus, Lepas, Talorchestia, Cancer, Limulus, Asterias, Arbacia, Echinarachnius, Thyone, Venus, Sycotypus, Loligo.

The course in vertebrate anatomy has been arranged for those who desire a thorough study of the vertebrate body. Though primarily a laboratory course, under the direction of the officers of the laboratory, there will be daily lectures upon anatomy, physiology, and kindred subjects by the following lecturers: Professor H. P. Bowditch, Dr. F. S. Lee, Dr. C. F. Hodge, Dr. O. S. Strong, Dr. C. S. Minot, Dr. J. S. Kingsley, Dr. J. P. McMurrich, Dr. H. F. Osborn. The first week will be devoted to the Elasmobranchs, the Dogfish (*Galeus*) and Skate receiving special attention. The second week will be devoted to the higher Fishes. During the third week the Batrachia will be studied. The fourth week will be devoted to the Reptilia.

Instruction in microscopical technique will extend throughout the month. Methods of section-cutting, differential staining, etc., will be taught, and histological preparations of the more important tissues will be made.

The fee for either of the above courses is $40.00, payable in advance. It covers tuition, material for dissection, dissecting instruments, laboratory outlines, drawing paper and instruments, slides and covers, and a supply of glassware and reagents. The laboratory loans, without charge, microtomes and certain other apparatus; there is a small fee, however, for the use of microscopes, and all who can provide themselves with simple and compound microscopes before coming to Wood's Hole, are urged to do so.

Applications should be made, at the earliest convenient date to, Professor H. C. Bumpus (until June 1), Brown University, Providence, R. I.; June 1–September 1, Wood's Hole, Mass.

The laboratory work in botany will be restricted to the study of the structure and development of types of the various orders of the cryptogamous plants. Especial attention will be given to the study of the various species of marine Algæ, which occur so abundantly in the waters about Wood's Hole, and students desiring to give their entire attention to these plants will be encouraged to do so. The Fungi and higher Cryptogams will receive less attention than the Algæ, but will be studied in a few types. Lectures will accompany the laboratory work. The course may be outlined somewhat as follows:

First week: Cyanophyceæ—Lyngbya, Calothrix, Rivularia, Stigonema, Tolypothrix, Anabæna.

Second week: Chlorophyceæ—Spirogyra, Ulva, Enteromorpha, Chætomorpha, Bryopsis, Vaucheria, Œdogonium.

Phæophyceæ—Ectocarpus, Mesogloia, Leathesia, Laminaria, Fucus, Sargassum.

Third week: Rhodophyceæ—Batrachospermum, Nemalion, Callithamnion, Chondriopsis, Rhabdonia.

Fourth week: Phycomycetes—Mucor, Sporodinia, Peronospora, Cystopus, Achlya.

Uredinei—Æcidium, Uredo, Puccinia, Uromyces.

Fifth week: Basidiomycetes—Agaricus, Lycoperdon.

Ascomycetes—Microsphæra, Sordaria, Peziza, Physcia.

Sixth week: Muscineæ—Riccia, Madotheca, Marchantia, Mnium, Tetraphis, Hypnum.

Filicineæ—Dicksonia, Adiantum, Equisetum, Lycopodium, Marsilia, Selaginella.

The tuition for students in the regular course of laboratory work and lectures is $40.00, payable in advance; for students engaged in investigation the tuition is $50.00.

For the course in embryology, the introductory courses in anatomy, or their equivalent, are considered as prerequisites. The course is designed as a preparation for beginning investigation. The aim will therefore be, not only to master the details of development, but also to acquire a thorough knowledge of the method of preparing surface-views, imbedding in paraffin and celloidin, staining and mounting, drawing, reconstructing, modelling, etc. The study will be mainly confined to the fish egg as the best type for elucidating vertebrate development; but the eggs of amphibia and other vertebrates, as well

as some invertebrates, will receive attention. Each member of the class will be supplied with material, and be expected to work out the successive steps in development, beginning with the egg just after fertilization. The laboratory work will be conducted by Doctors Lillie and Strong, and accompanied with lectures and seminar work under the Director. The fee for this course is $50.00, and the class is limited to twelve.

Applicants should state what they have done in preparation for such a course, and whether they can bring a complete outfit, viz.: a compound microscope, a dissecting microscope, camera-lucida, microtome, etc. In case these instruments are furnished by the laboratory, an additional fee of $10 will be charged therefor. No application for less than the whole course will be granted.

For those prepared to begin original work, ten tables are reserved in zoology, and the same number in physiology and botany. The introductory and preparatory courses in each department, or an equivalent, are prerequisites for admission to these tables. Ability to read scientific German and French is also required. Special subjects for investigation are assigned to the occupants of tables, and the supervision of the work is so divided that each instructor has the care of but three or four students. In this way all the advantages of individual instruction are secured. All the lectures and the seminar are open to those engaged in such work. The fee is $50.

The forty private laboratories for investigators are distributed as follows:—Zoology, 22. Physiology, 8. Botany, 10.

These rooms are rented at $100 to colleges, societies or individuals.

The general laboratories are for the use of students engaged in special research under the supervision of the Director and his assistants, and for advanced courses preparatory to beginning investigation, such as the course in embryology. There are forty-two tables, of which zoology has twenty-two, physiology ten, and botany ten.

The seminar is especially designed for members of the class in embryology and beginners in investigation, but is open to all. It is expected that all who attend will be provided with the third volume of the Biological Lectures, as this will be made the basis of discussion. Most of the authors of these lectures will be present, and from two to three mornings will be devoted to the consideration of each lecture, and such questions as may be raised.

Wood's Hole is situated on the north shore of Vineyard Sound, at the entrance of Buzzard's Bay, and may be reached by the Old Colony Railroad (two and one-half hours from Boston), or by rail and boat

from Providence, Fall River, or New Bedford. Rooms accommodating two persons may be obtained near the laboratory at prices varying from $1.00 to $3.00 a week, and board from $4.00 to $6.00. Board will be supplied to members at The Homestead at $5.00 a week.

The location of the Laboratory at Wood's Hole, gives it exceptional advantages for study and research. The shore is varied by necks, points, flats, gutters, holes, bays and islands; there are numerous fresh-water ponds and lakes in the vicinity; there is no muddy river or city sewerage to pollute the sea-water; the fauna and flora are exceptionally rich; the climate is especially favorable for summer work, and the place is free from the inconveniences and distractions of fashionable summer resorts.

The Laboratory consists of four two-story buildings, with forty private rooms for the exclusive use of investigators, and seven general laboratories. It is supplied with aquaria, collecting apparatus, reagents, glassware, and a limited number of microtomes and microscopes for use in the introductory courses. The investigators' rooms are furnished with glassware and reagents, but not with microscopes and microtomes. No alcohol is supplied beyond what is allowed for the work done in the laboratories; and expensive reagents, such as osmic acid and gold chloride, are not included in the list of free reagents. The laboratory has a steam launch, boats, dredges, and all the apparatus necessary for collecting and keeping alive material reserved for class work or research.

The library is provided with many works of reference and the more important journals of zoology and botany, some of them in complete series. Members of the Laboratory are allowed the use of books from the Library of the Boston Society of Natural History, through the courtesy of the Curator and the Librarian.

A department of laboratory supply has been established in order to facilitate the work of teachers and others at a distance, who desire to obtain material for study or for class instruction. Certain sponges, hydroids, star-fishes, sea-urchins, marine worms, crustaceans, mollusks, vertebrates and marine plants are generally kept in stock, though larger orders should be filed some time before the material is needed. Circulars giving information, prices, etc., may be obtained on application.

Bowdoin College Summer Courses in Science.—Beginning July 9, 1895, and continuing for five weeks, the following courses in science will be conducted by instructors in Bowdoin College at the

Searles Science Building, Brunswick, Maine.

(1) A course in Elementary Chemistry.

(2) A course in Advanced Chemistry.

(3) A course in Physics.

(4) A course in Biology.

These courses are designed especially for teachers, but are open to all earnest workers. It is believed that they will be well adapted to the needs of any student of natural science, giving, for example, an excellent introduction to the study of medicine or pharmacy. They will also be valuable to those who, either as teachers or scholars, are preparing to meet natural science requirements for admission to college. They will consist largely of practical work in the laboratory, and it is doubtful if any college laboratories in the country have superior facilities for this purpose.

Each elementary course will consist of lectures and laboratory work for two hours a day on five days of the week. No exercises will be held on Saturdays. Students in the advanced chemistry course can work in the laboratory as many hours a day as the instructor thinks advisable. A student in a single elementary course is not entitled to more than the regular time of work for that course, ten hours per week.

The fees for the courses, paid invariably in advance, are as follows:

For two or three elementary courses,	$20.
For a single elementary course,	$10.
For advanced chemistry,	$15.

An extra charge will be made for chemicals used and apparatus injured in any course. Experience proves that such charge need not exceed three dollars.

Board and lodging can be obtained in Brunswick at a cost of from $4 to $6 per week.

Occasional evening lectures on scientific topics of a general nature may be expected from the different instructors.

The next Meeting of the American Microscopical Society will he held at Cornell University in Ithaca, N. Y., August 21, 22 and 23, 1895, that is, the week previous to the meeting of the American Association for the Advancement of Science, which is to be held in Springfield, Mass.

The unsurpassed beauty of the location of the University, and the richness of both its terrestrial and aquatic fauna and flora, make this an ideal place for holding the meeting. It is equally attractive to the

student of natural history and to those who love beautiful scenery. The facilities of the University and its equipment in all lines for carrying on microscopical work add to the attractiveness of Ithaca as a place of meeting.

The University buildings, which will be held at the disposal of the Society, are especially adapted for the formal presentation of papers, blackboard illustrations, hanging of diagrams, etc., as well as for any demonstration that authors may desire to make. The armory is very convieniently located both for the University and for the city, and a soiree there can hardly fail to be a great success.

Besides the attraction of papers and demonstrations by members, nearly all the opticians have expressed not only a willingness but a desire to be present and make an exhibit of their microscopes and microscopical apparatus, thereby affording the members an opportunity to see all the new and standard apparatus.

A special feature of the coming meeting will be the setting apart of one or more sessions for the reading of papers on methods and demonstration of special or new methods. The chairman of the local committee, Professor W. W. Rowlee, or the President, Prof. S. H. Page, will be glad to receive requests from those who desire to have some specially difficult method or structure elucidated, and an effort will be made to get some member particularly expert in such subject to demonstrate it before the Society.

Summer Zoological Laboratory of the Indiana University will be located at Vawter Park, the highest point on the southwestern shore of Lake Wawasee or Turkey in Kosciusko county. Wawasee is about nine miles long by three miles wide. In the immediate neighborhood are many lakes, some drained into Lake Michigan, others into the Wabash; a short distance to the east is the basin of Lake Erie and still a shorter distance to the west is the Illinois River basin. An hour's ride from the station over the moraine separating the Mississippi system from the St. Lawrence system will bring us to Webster, Tippecanoe and the Barber Lakes of the former system.

Research.—The main object of the station will be the study of variation. For this purpose a small lake will present a limited, well circumscribed locality, within which the differences of environmental influences will be reduced to a minimum. The study will consist in the determination of the extent of variation in the non-migratory vertebrates, the kind of variation whether continuous or discontinuous, the quantitative variation, and the direction of variation. In this way

it is hoped to survey a base line which can be utilized in studying the variation of the same species throughout their distribution. This study should be carried on for a series of years, or at least be repeated at definite intervals to determine the annual or periodic variation from the mean. A comparison of this variation in the same animals in other similarly limited and well circumscribed areas, and in the correlation of the variation of a number of species in these areas will demonstrate the influence of the changed environment, and will be a simple, inexpensive substitute for such expensive experimental work.

Instruction.—Courses of instruction which ordinarily cannot be given in the University's laboratories during the college year will be offered and credit given on the University's records. The courses are as follows:

1. *Elementary work.* The class will collect, preserve and study a series of animals occurring in the neighborhood of the station. Emphasis will be laid on the nature of the freshwater fauna and the correlation and adaption of organisms. The entire day will be given to collecting excursions, laboratory work and lectures. Individual work Saturdays. No special preparation is needed. (Teachers may collect material for their classes, but alcohol for this purpose will not be furnished).

2. *Embryology* and life history of fishes and other local forms.

3. *Special investigations* in the variation of non-migratory vertebrates and survey of the physical and biological conditions of Lake Wawasee.

Courses 1 and 2 will extend through five weeks beginning June 25th. Course 3 may extend at the pleasure of the investigator till the middle of September.

Lectures.—A number of biologists will be present for a short time, several of whom have promised to lecture. Among those who will be present are: J. C. Arthur, Purdue University, Slime molds, the fungous-like animals; A. W. Bitting, Purdue University; E. P. Boyer, Chicago High Schools, Biology in the High Schools; R. E. Call, Louisville Manual Training High School, Freshwater molluscs; W. S. Blatchley, State Geologist, Insects and how to collect them; G. Baur, Chicago University, How to study Variation: J. M. Coulter, President Lake Forest University, (Subjects not yet announced); B. W. Evermann, U. S. Fish Commission, Field work of the U. S. Fish Commission; The Red Fish; P. Kirsch, Indiana State Fish Commissioner; L. J. Rettger, Indiana State Normal School, Some topic in physiology; Joseph Swain, President Indiana University, (Subject not yet announced).

State Geological Survey of Kansas.—In conformity with the law under which the University of Kansas is now working, the Board of Regents at a recent meeting formally organized the University Geological Survey of Kansas with Chancellor F. H. Snow, ex-officio Director; Professor S. W. Williston, Paleontologist; Professor Erasmus Haworth, Geologist and Mineralogist; and Professor E. H. S. Bailey Chemist.

In addition to these, other members of the University Faculty, as well as the advanced students of the departments of Geology and Paleontology, will be engaged upon the work of the Survey. An effort will also be made to centralize and unify the energies of different geologists in the State who have been doing valuable work along different lines of geological investigations. Already a considerable start has been made and the co-operation of different geologists of the State has been secured.

Work in the Coal Measures of the State has been in progress for two summers, and Volume I of the Report is now almost ready for publication. Other volumes will appear at irregular intervals. Those already under preparation are: One on Coal, Oil and Gas; one on the Vertebrate Paleontology of the State; and one on the Salt and Gypsum deposits of Kansas.

The Summer Course of the University Extension Association will be held at the University of Pennsylvania in July, 1895, the course in Biology extending from July 1st to 26th. The lectures and laboratory courses will be conducted by L. H. Bailey (Cornell), E. D. Cope (Pennsylvania), G. L. Goodale (Harvard), B. D. Halsted (Rutgers), J. M. Macfarlane (Pennsylvania), J. S. Kingsley (Tufts), C. O. Whitman (Chicago), W. P. Wilson (Pennsylvania), L. L. W. Wilson (Philadelphia Normal School).

The Missouri State Horticultural Society will hold its Semi-Annual Meeting at the Opera House, Willow Springs, Mo., June 4, 5 and 6, 1895. The Kansas City, Ft. Scott and Memphis and Central Branch Railways will give a rate of half fare for round trip. The San Francisco and Missouri Pacific Railroads will give a rate of one and one-third fare on the certificate plan. Hotels will give rates of $1.00 per day and 75 cents per day.

The Colorado State Science Teachers' Association held its first meeting—since its organization in December last—in Denver, April 3d inst. The object of the association is to promote a better grade of instruction in the elementary schools and high schools of the State.

The Lehrbuch der praktischen vergleichenden Anatomie of Vogt and Yung is at last complete. It was begun in 1885.

The German Zoological Society will hold its annual meeting at Strasburg, June 4–8, 1895.

One boa in the zoological gardens of London recently swallowed another of his species which nearly equalled him in size.

Dr. Lewis R. Gibbes, of Charleston, S. C. died in that city, November 21, 1894. He was born there Aug. 14, 1810. In his early days he he was an ardent zoologist and the Proceedings of the Elliot Society (of which he was one of the founders) the American Association for the Advancement of Sciences and other journals formerly contained numerous systematic papers from his pen. Since the war he has left the zoological field, and has occupied the chair of mathematics and astronomy in the college of Charleston.

Dr. Bela Haller, well-known for his Molluscan studies, is now privatdocent at Heidelberg.

The bibliographical movement recorded in the columns of our January issue is making considerable progress towards its complete organization. The ultimate success of the undertaking now seems highly probable. In France, the organization has reached its greatest perfection and as an example of what is needed in America we may briefly describe what has been done by a number of zealous French zoologists. The annual meeting of the French Zoological Society held in February, 1894 had already discussed the matter in a preliminary way and had referred the decision to the Council of the Society. After mature consideration the Council of the Society designated one of its members, Prof. Bouvier, vice-president of the Society to study all the details of the project and to report upon them at a subsequent meeting. This report of M. Bouvier was presented in February last and was unanimously approved by the Council who ordered it to be presented before the Annual Reunion of February 28.

Basing its decisions upon this report as well as upon the recommendations of the Council, the Society nominated a permanent central *Commission de patronage et de propagande* comprising the following persons:—Prof. Blanchard, Prince Bonaparte, Prof. Delage, Prof. Filhol, Prof. Gandry, Baron de Guerne, Prof. Milne-Edwards, Prof. Raillet and Prof. Vaillant. As associate members twenty zoologists chosen to represent the various publishing centres of the country were nominated. It is through their agency that the central commission hopes to reach every part of France and to secure all the strictly zoological publications needed for the Bureau's work. Journals rarely containing zoological papers as well as any zoological journals or books which the Bureau

should be unable to obtain will be examined by a body of eleven special correspondents who have been secured for this purpose. They are distributed as follows. Prof. Bouvier, Botany, Chemistry, and Pharmacology; Prof. Baudouin, Anthropotomy, Physiology, Pathology, and Medicine; Prof. Hervé, Anthropology; Prof. Lignières, Veterinary Science; M. Roché, Chief Inspector of Fisheries, Pisciculture; M. Caustier, Sec. Soc. Acclimatization; M. Boule, Asst. in the Nat. Hist. Museum, Vertebrate Palæontology, M. Haug, Instructor in the Faculty of Science, Invertebrate Palæontology; M. Denicker, Chief Librarian of the Nat. Hist. Museum, Separate Books and certain journals accessible in the Nat. Hist. Library; M. Léveillé, Librarian of the Entomological Society, Books and Journals accessible in the Entomological Library; M. Richard, Sec. Zool. Soc., Journals accessible in the Zoological Society's library or in that of this Philomathic Society and the Society ordered; M. Bouvier's report to be printed and distributed at once.

A preliminary inquiry among a number of learned societies and the leading publishing firms of Paris seems to indicate that almost all the journals as well as the separate works of interest for the Bureau will be sent to it gratuitously. Publishers and learned societies alike can only profit by having their publications made known promptly to those persons who would wish to use them. *Not a single failure to accept the invitation to co-operate has thus far been encountered.*

In Russia also a distinct advance has been made in the last two months; but the conditions are here too different to serve as a model for what we hope may soon be accomplished in America.

The Third International Zoological Congress will meet at Leyden, Holland, September 16–21, 1895. The Netherlands' Zoological Society has taken upon itself the task of making all the arrangements for the meeting. Their Excellencies, the Minister of the Interior, and of the Public Works, of Commerce and Industry, will be the Honorary Presidents of the Congress; Dr. P. P. C. Hoek (Helder), General Secretary, and Dr. R. Horst (Leyden) Treasurer. The following scheme for the Sectional Meetings has been adopted: 1*st section,* General Zoology, Geographical Distribution, including fossil faunas; The Theory of Evolution.—2*d Section,* Classification of Living and Extinct Vertebrates, Bionomy, Geographical Distribution, including Fossil Vertebrates.—3*d Section,* Comparative Anatomy of Living and Extinct Vertebrates; Embryology.—4*th Section,* Classification of Living and Extinct Invertebrate Animals; Bionomy.—5*th Section,* Entomology. 6*th Section,* Comparative Anatomy and Embryology of Invertebrate Animals.

The circular of announcement for the meeting has been signed by 310 Zoologists.

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The Contributors, who are all Scholarly gentlemen and specialists will continue as before, but several new names will be added.

The following may be mentioned as having contributed to the Volume for '94.

Dr. D. G. Brinton, Rev. Wm. M Beauchamp, Prof. A. F. Chamberlain, Mr. James Deans, G. O. Dorsey, Dr. J. Walter Fewkes, H. C. Mercer, Mrs. Zelia Nuttall, C. Staniland Wake, Dr. Wm. Wallace Tooker, Dr. Cyrus Thomas. The Magazine during '95 will embrace different departments, and the following gentlemen will have charge and report all explorations and discoveries:

Rev. Wm. C. Winslow, D. D., L. L. D., Egypt.
Prof. T. F. Wright, Explorations in Palestine.
Henry W. Haynes, Paleolithics and European Archaeology.
Dr. A. S. Gatschett, Indian Linguistics.
Marshall H. Seville, Mexico and Central America.
Hon. James Wickersham, The North West Coast and Eastern Asia.

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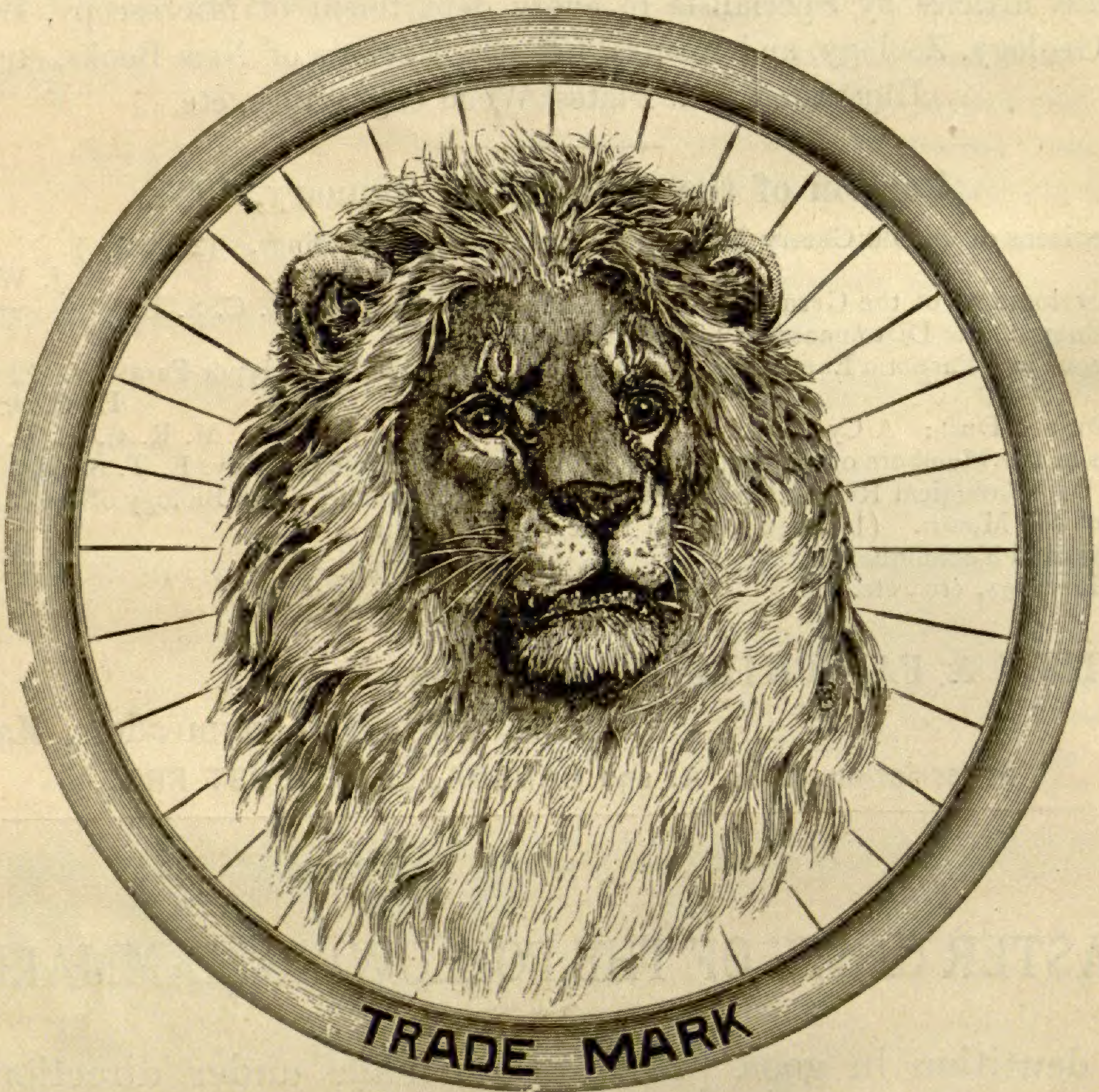

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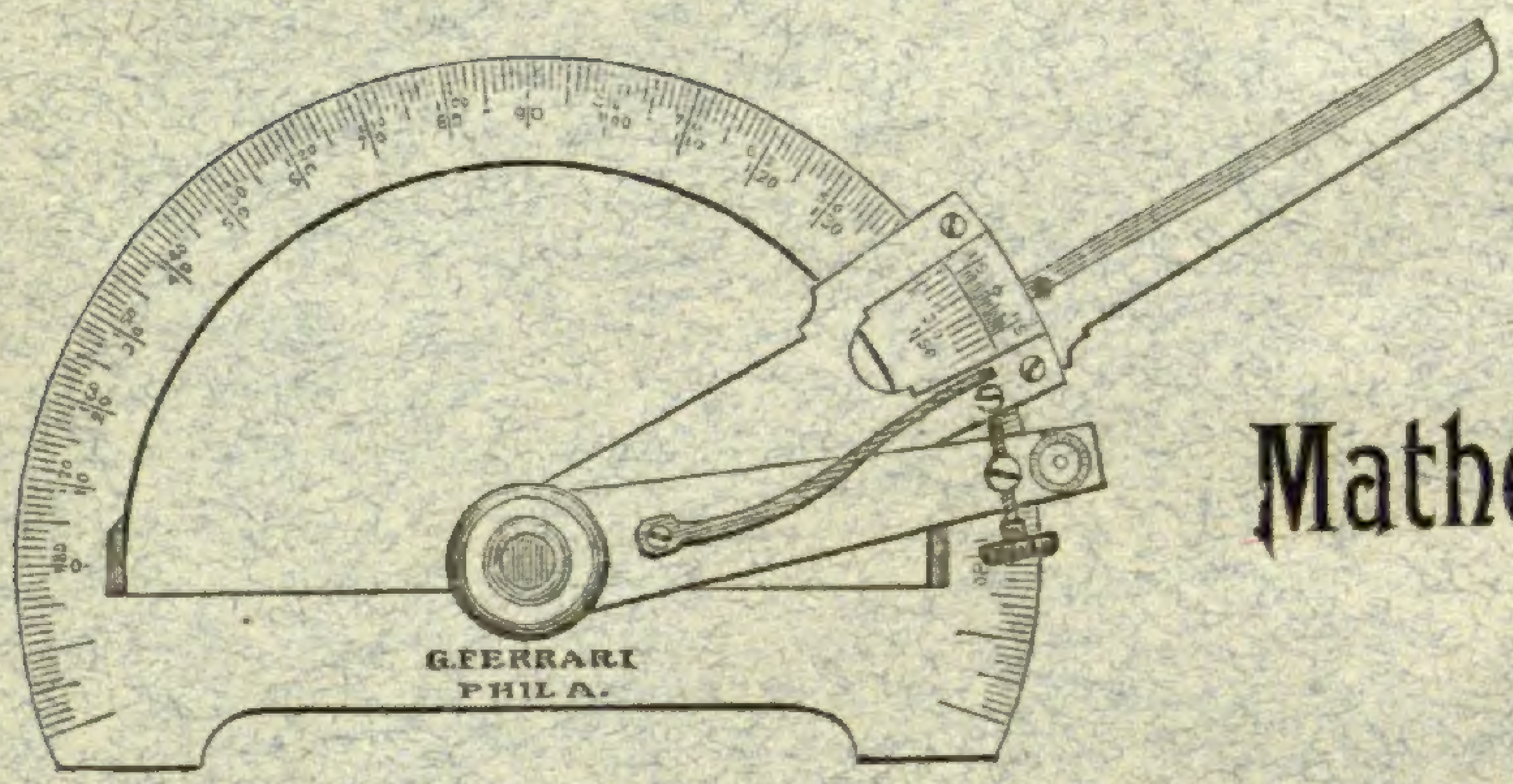

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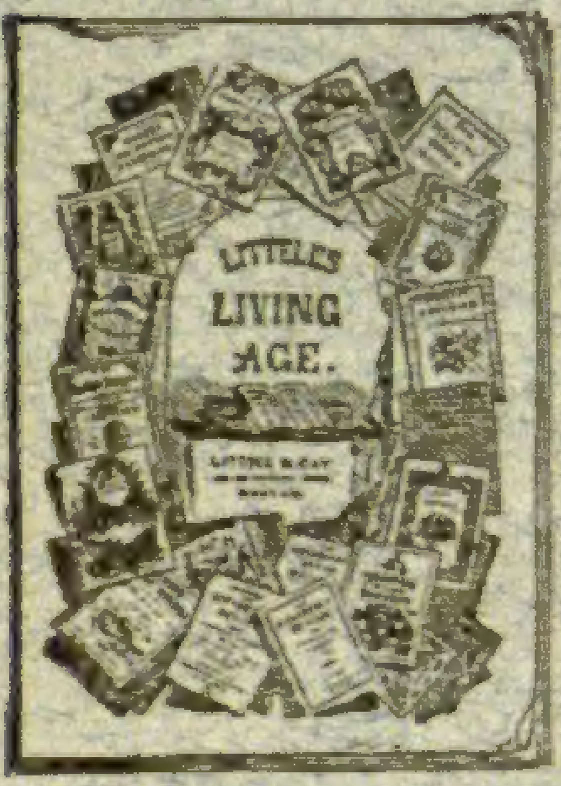

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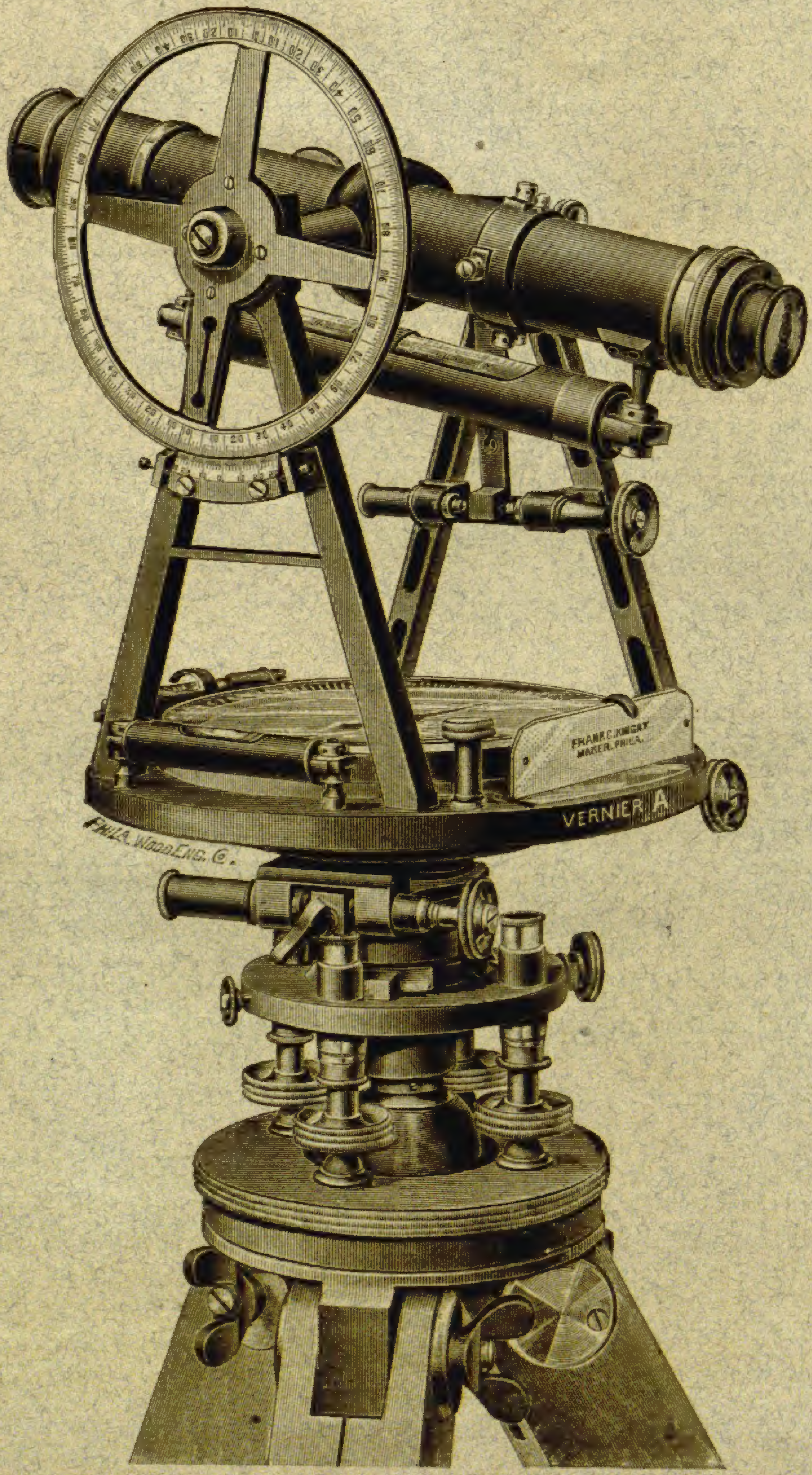

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